CHEMICAL
& Metallurgical
ENGINEERING

For DECEMBER, 1945 • CHEMICALS DERIVED FROM PETROLEUM • SYNTHETIC AMMONIA FROM NATURAL GAS • SALVAGE THOSE CHEMICAL ENGINEERS • OAK RIDGE GIVES INDUSTRY A UNIT OPERATION, GAS DIFFUSION • NEW PELLET DRYER OFFERS DIVERSE USES • ALUMINA PRODUCED FROM NORTHWEST CLAY • PHOSPHATE PHILOSOPHY

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In this Issue

An index to advertisers will be found on page 462

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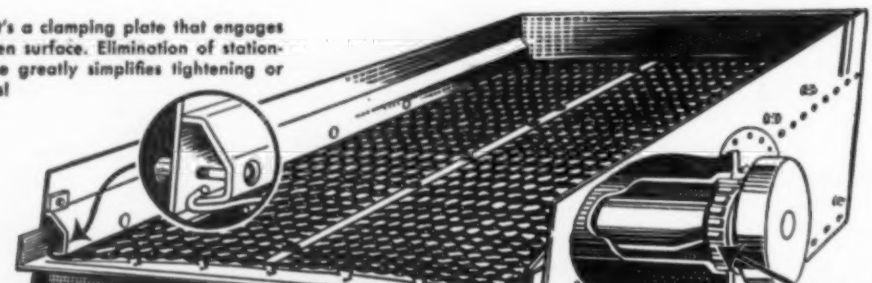

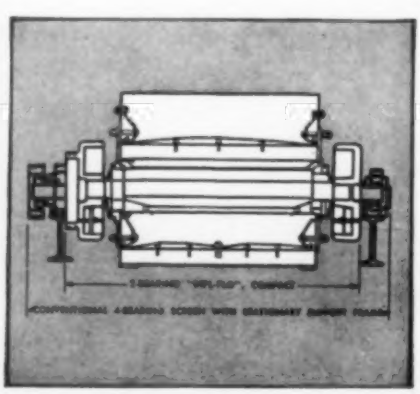

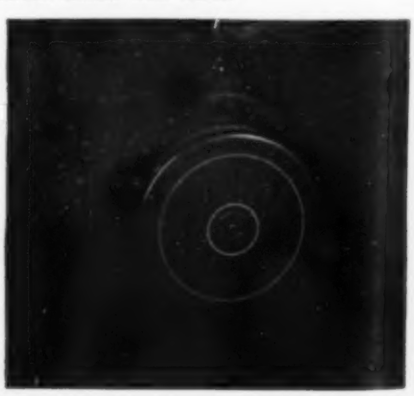

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S. D. KIRKPATRICK, Editor

DECEMBER, 1945

Rebuilding Our Most Basic Reserves

OPPOSITION to some of the plans for a National Research Foundation, as originally proposed by the Bush committees, comes principally from two camps. One is that of a few entrenched bureaucrats who naturally resent any intrusion into their well guarded fields and who are fearful that a new agency might undermine their congressional support and appropriations. The second group, as yet somewhat less articulate, opposes nationally sponsored research for fear it would increase bureaucracy and ultimately lead to governmental control and operation of industries. Thus we have the strange and apparently inconsistent situation of the bureaucrats and those who oppose further bureaucracy united in their stand against some of the plans that deserve impartial study and support in the public interest. Both groups, in our opinion, are exceedingly short sighted if they have overlooked the most important principle in the Bush recommendation—namely, governmental support of pure or basic research, as contrasted with applied research.

In his classic report to President Truman last July, Dr. Bush wrote: "Basic research leads to new knowledge. It provides scientific capital. It creates the fund from which the practical applications of knowledge must be drawn." During the war we have overdrawn our account. Technological advances have actually overtaken scientific knowledge and in some fields we are stopped from further progress for want of primary investigations in pure science. In the future we cannot depend as largely as we did in the past on the basic discoveries of European scientists. And we cannot have long continuing progress in technology unless we start replenishing our supply of new basic facts and principles. Every important element of industry, education and government must recognize this need as a national problem and make certain that the issue is not confused with political promises of a bright new world of research, full of gadgets and profitable processes to be freely licensed to all businesses.

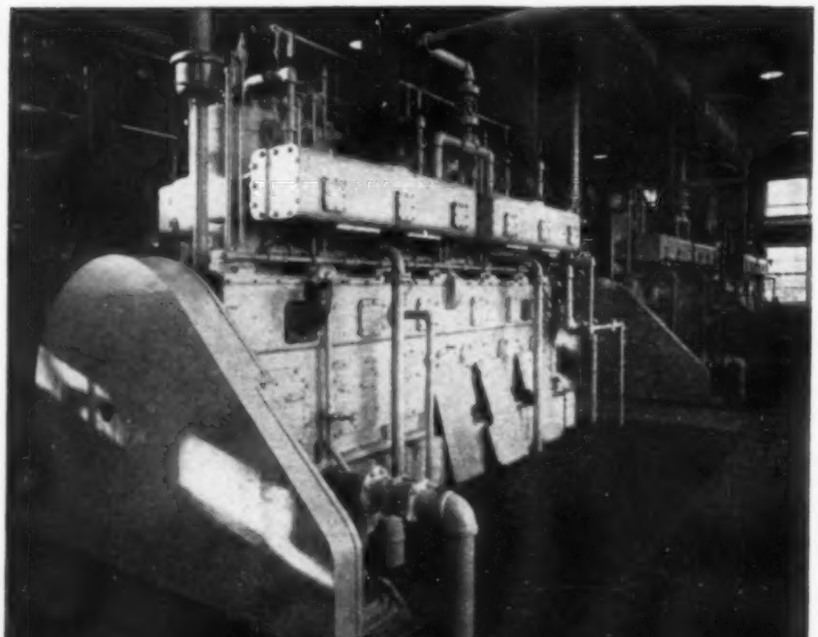
Basic research is primarily done in colleges, universities and research institutes. By its very nature it is not for profit because it is usually performed without thought of practical applications. It can seldom flourish in either industrial or governmental laboratories, if the emphasis must be only on results that can be translated into profits—or congressional appropriations. During the war, of course, many of the contracts of OSRD and other agencies with the universities were for military investigations and the type of applied research that would normally have been carried on in industrial laboratories. This is a trend that should not be encouraged too far because the colleges should return their emphasis to education and basic research. Throughout the Bush report there is the repeated recommendation that technology and applied science should be left to private enterprise.

If we can be sure that the new legislation is so framed as to put proper emphasis on basic rather than applied research, we will have taken the first step toward a sound national policy on science. If we can set up proper incentives for stimulating education and the accumulation of new basic knowledge and at the same time provide safeguards against excursions into the fields of competitive enterprise, we will have charted a true course in the public interest. The present controversial issues on the ownership of patents and the procedures for their licensing become of lesser importance as the greater emphasis is placed on fundamental research. Nevertheless, these provisions must be such as to discourage rather than build up a new bureaucracy of governmental controls. We cannot afford to shut our eyes to these dangers that are inherent in any nationally subsidized program. But we believe that they are far less serious for the American people and American industry, than the dangers in proceeding without a program for rebuilding our basic reserves of fundamental scientific information.

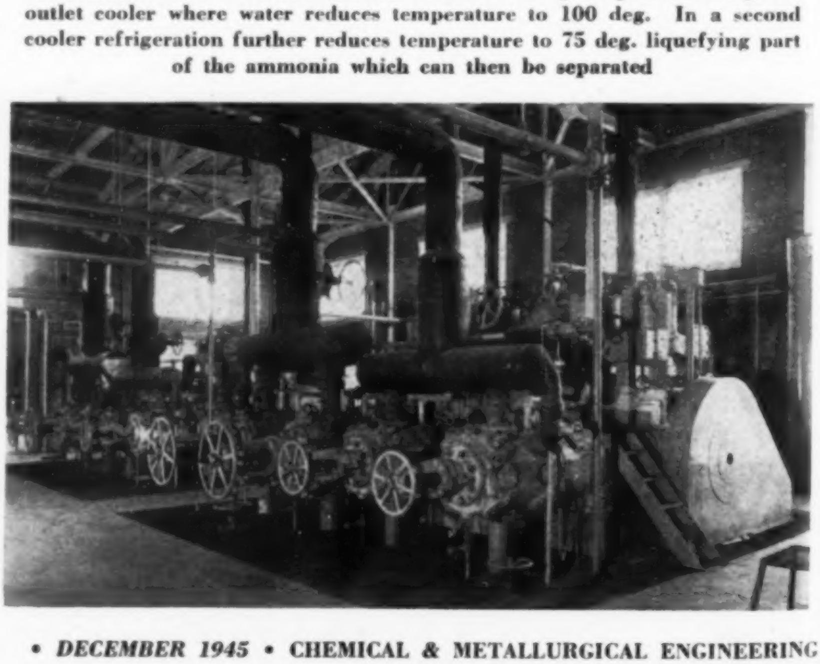
JAMES A. LEE *Managing Editor, Chemical & Metallurgical Engineering*

SYNTHETIC AMMONIA
Produced From Natural Gas

Here for the first time is told the story of the production of synthetic ammonia in one of the new plants in which natural gas is used as the source of the hydrogen. The purification system where the sulphur is removed, the reforming, converting and other operations in the preparation of the synthesis gas will be of particular interest to chemical engineers. The conversion of the synthesis gas to ammonia, and its separation and recovery follow standard practice.—*Editors*

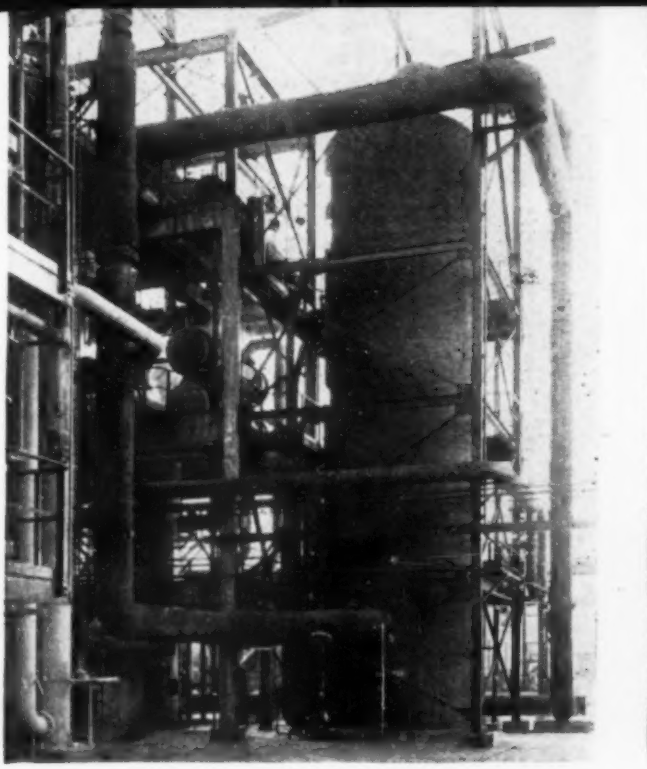


Refrigeration compressors in Lake Charles, La., plant operated by Mathieson Alkali Works. Gas leaving converters at 375 deg. F. passes through an outlet cooler where water reduces temperature to 100 deg. In a second cooler refrigeration further reduces temperature to 75 deg. liquefying part of the ammonia which can then be separated

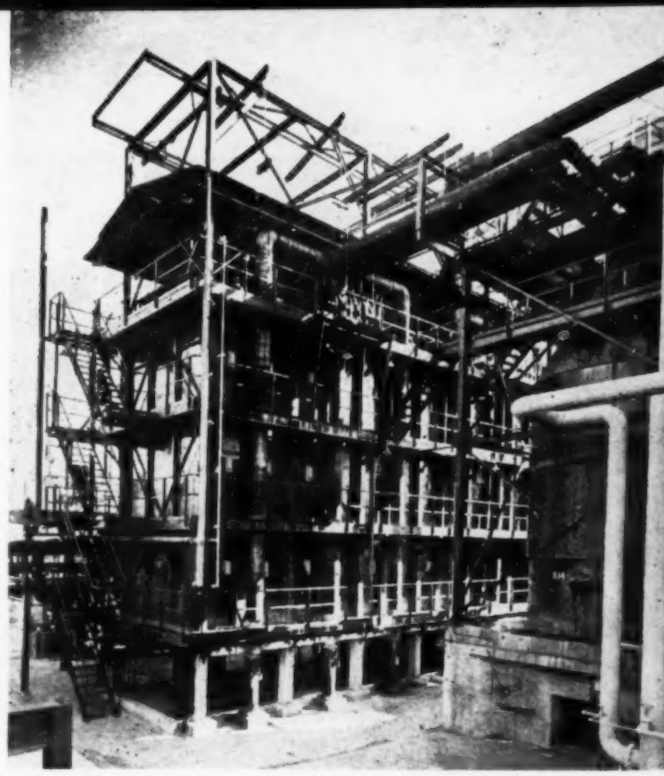


STANDARD practice in this country has long been to make synthetic ammonia from water gas. Such a process is in operation at TVA and was described in *Chem. & Met.* in November, 1943, (pp. 119-125). However, this particular plant, through necessity of the times (1941-42), included some innovations. From India comes word that a plant now under construction will depend upon wood from which to make charcoal for its source of hydrogen. In our own country we have, in designing our three plants which were constructed during the war for the Defense Plant Corp., gone to natural gas as the source of the hydrogen. One of these plants is at Lake Charles, La., and is operated by Mathieson Alkali Works. It differs from the other two only in certain gas purification features which Mathieson's own engineers have developed.

Natural gas for the Lake Charles plant is obtained from Tepetate and South Roanoke fields of the Continental Oil Co., about 40 miles east. The gas is brought to the plant in a special pipe line. It reaches its destination at 300 lb. pressure and is reduced, at the entrance to the plant, to from 50 to 75 lb. Since the



Gas is passed through a catalyst chamber or shift converter at 800 deg. F. to convert CO to CO_2



Reformer furnace and combustion chamber used in making hydrogen from natural gas for ammonia synthesis

volume consumed daily is quite large, storage in gas holders is economically impractical.

On reaching the plant the gas first goes to a purification system where sulphur is removed. In order to do this it is first preheated and then passed up through towers filled with trays of bauxite which act as a catalyst. The bauxite has a life of from two to three years, but alternate towers are closed down from time to time in order to steam out the deposited sulphur.

The sulphur-free gas passes from the scrubbers to a so-called reformer furnace. It enters the top of the furnace and flows downward at a pressure of 30 lb. through tubes (25 percent chromium and 20 percent nickel steel) surrounded by hot gases as in a steam boiler economizer. These tubes are filled with a suitable catalyst for dissociating the methane of the gas into hydrogen, carbon dioxide and carbon monoxide. To aid in this disassociation steam is admitted along with the purified gas. The gas leaves the bottom of the tubes at a temperature of 1,300 deg. F. The skin temperature of the tubes is about 1,700 deg. F.

From the reformer furnace, the disassociated methane passes to a combustion chamber, to which preheated steam, methane and air are also supplied, and as much as possible of the undisassociated methane and part of the carbon monoxide are consumed. The air is introduced in such volume that the mixture leaving the chamber will have the required percentage of nitrogen for the ammonia production. The gas leaving the combustion chamber is at a temperature of 2,000 deg. F. and contains approximately 40 percent hydrogen, 11 percent carbon monoxide, 4 percent carbon dioxide, and 28 percent water.

The gas next enters the bottom of a so-called quench chamber where its temperature is reduced to 800 deg. F. by a spray of water. Leaving the top of the quench chamber there is very little methane left. The gas consists of hydrogen, nitrogen, carbon monoxide and carbon dioxide; the last two in the ratio of 3 CO to 1 CO_2.

It is necessary to convert all of the residual carbon monoxide to the dioxide. For this purpose the gas is passed through a catalyst chamber or shift converter at 800 deg. F. This shift converter tower is standard in all synthetic ammonia plants whether generating hydrogen from coke, coal or natural gas.

SYNTHESIS GAS

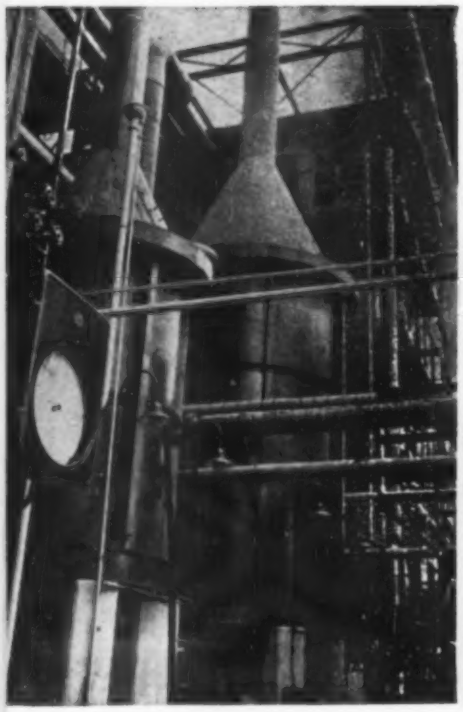
The hot gases enter tubular water coolers which reduce the temperature. And from there the cooled gases enter a three-lift gas holder of 500,000 cu. ft. capacity. This gas is low in carbon monoxide (less than 1 percent); the carbon dioxide content is 16 percent, the balance is hydrogen and nitrogen, in stoichiometric ratio, together with small amounts of inert gases. The gas holder is located midway in the process so that either the preparatory or the production department of the process can be shut down for minor repairs without affecting the operation as a whole.

Synthesis gas from the holder goes through the first two stages of the five stage primary compressors before entering the Gerbitol carbon dioxide absorber. The compression (1) reduces the volume of gas passing through the absorber and (2) increases the efficiency of the absorbing solution. A heat exchanger ahead of the absorber reduces the temperature of the synthesis gas to 100 deg. F. As the gas enters the bottom of the absorber it is at a pressure of 200 lb. per sq. in. The monoethanolamine solution entering the top of the tower flows counter current to the synthesis gas and absorbs the carbon dioxide. The spent monoethanolamine solution is regenerated by heating it with steam, which drives off the carbon dioxide. The solution is returned to the absorbing system for reuse.

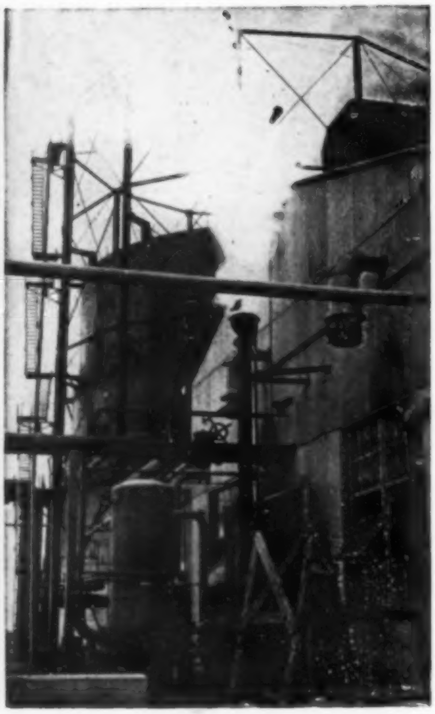
Due to the temperature of the m.e.a. fed to the top of the absorber the gas leaves it at the same temperature at which it enters, 100 deg. F. From the absorber the gas goes to a knockout drum. Here the entrained moisture is removed. The dry gas then passes through the third and fourth stages of the primary compressors. These stages increase the pressure to 2,100 lb. per sq. in. A heat exchanger reduces the temperature and the gas is ready for the removal of the last traces of carbon monoxide. The gas enters the bottom of a tall vertical pressure vessel and flows countercurrent to a solution of cuprous and cupric formate with which the monoxide forms an unstable compound and is absorbed.

Any traces of acetylene which might exist in the gas will combine with the cuprous formate to form cuprous acetylide, which is highly explosive when dry, though harmless when wet. Provisions are made to remove from the plant all the cuprous acetylide that might form, in a wet state.

Spent formate solution leaves the absorber and is pumped to the reclaiming unit where it is heated with steam in order to drive off the absorbed carbon monoxide.



Natural gas is preheated before entering the purification system



Three-lift gas holder of 500,000 cu. ft. is located midway in process

It is then returned to the absorber for reuse.

The gas next passes through a knockout drum where the entrained moisture is removed and from there to the fifth stage of the primary compressors, which raises the pressure to 4,000 lb. per sq.in. plus or minus depending on rate of production. After passing through heat exchangers and carbamate traps it goes to the three ammonia converters, each containing 12 beds of promoted iron catalysts. The reaction in the converters takes place at about 925 deg. F., the gas leaving the converters at 375 deg. F. contains in the neighborhood of 16 percent ammonia. It passes through a converter outlet cooler where water reduces the temperature to 100 deg. F. In a second cooler refrigeration further reduces the temperature to 75 deg. F. liquefying part of the ammonia. The gases and liquid anhydrous ammonia enter the primary separator in which the liquid ammonia collects in the bottom and is drained off from the circulating synthesis. The gases leaving the top of the separator contain 4.5 percent ammonia, non-condensible gases, and hydrogen and nitrogen. The non-condensible gases, consisting of methane and argon, are removed by a purge line near the primary separator. They must be removed for they would build up a head pressure on the primary compressor.

The gases then pass to high-pressure booster compressors known as circulators. These compressors return the gas to the entrance of the ammonium carbamate traps where it joins the gas coming from the primary compressors. Ammonium carbamate is formed by action of carbon dioxide that was not removed in the absorber, on the ammonia. From time to time the trap has to be cut out of the system and steamed out. The gases leaving the carbamate traps go to a chiller where refrigeration reduces the temperature from 100 to 25 deg. F. and then through a separator where more liquid ammonia is removed. After this separation the gases containing residual ammonia of about 2½ percent finally are returned to the converter. By means of a system of heat exchangers located in the lower part of the converter the temperature of the incoming cool gas going to the catalyst bed is raised and that of the outgoing gases is lowered to about 375 deg. F.

Liquid ammonia which is drained from the gas in the separators, is stored in insulated Hortonspheres. The pressure is controlled by refrigeration. The safety valves are set at 75 lb. From these storage vessels ammonia can be pumped to tank cars on the adjoining siding, or to the nearby ammonium nitrate plant for the production of fertilizer.

CONSTRUCTION STARTED

It was on Mar. 27, 1942 that a contract was signed between the Mathieson Alkali Works and the Defense Plant Corp. for the building of the new ammonia works. According to this contract Mathieson with its know-how of synthetic ammonia production was to supervise design and construction and then to operate the plant on a lease basis. Mathieson had been one of the first to produce synthetic ammonia in this country on a commercial scale. A subcontract for design, engineering and construction was arranged by Mathieson with M. W. Kellogg Co. on Aug. 20, 1942. The plant was completed and put into operation on Sept. 19, 1944.

PEACETIME POSSIBILITIES

While the plant was built and operated as a war plant, it was anticipated from the beginning by company officials that it would be used to make chemical fertilizers for the southern market after the war.

The original Mathieson plant at Lake Charles produces soda ash and caustic. It was erected in 1934. Five years had been spent in determining the best location for the plant. Lake Charles was selected because of limitless supplies of salt and oyster shells, and splendid water and rail transportation. The 31-ft. deep water ship channel permits direct loading into ocean-going steamers bound for either domestic or foreign markets.

Since 1934 the Mathieson operated group of plants at Lake Charles has grown rapidly reaching a total investment of approximately seventy million dollars. The ammonia unit alone covers an area of nearly four acres and represents an investment in excess of $10,000,000. The plant was designed to take full advantage of centralized grouping. The layout of all units was arranged in relation to their respective functions. This coordination facilitated the centralizing of power distribution to the various structures, thus achieving maximum of service and economy of operation at a minimum installation investment.

Provisions were made in design and construction for many safeguards against ammonia fumes. All of the units where fumes may be given off are located in the open air, which assures prompt and complete dissipation of noxious odors and eliminates the dangers of trapping fumes in small enclosures where they might constitute a hazard.

Particular significance is attached to the provisions made for laboratory checking. The plant of course has a complete laboratory for control of production. In this project a special piping system has been installed connecting every unit with the laboratory. Thus the laboratory staff can make a check every minute if necessary of any material at any phase of the operation. The net effect therefore is to facilitate greatly the important task of sampling.

All buildings and exposed constructions are designed with a factor of safety appropriate for a region where winds of hurricane proportions are frequent. Labor conservation was considered in designing the plant and many labor-saving devices installed. Operations require about a hundred and fifty men.

For diagrammatic and pictured flowsheets of the plant and process, the reader is referred to the *Chem & Met.* Pictured Flowsheet on pages 134-137 of this issue.

B. H. HOPKINS *Chemical Engineer, Detroit, Mich.*

SALVAGE
Those Chemical Engineers

Chemical management is facing a critical situation in its engineering resources just as the postwar expansion programs get underway. The shortage of engineers that was felt during the war years will continue until 1950. To meet this situation the author offers industry a six-point program for salvaging those chemical engineers who are already on the payrolls and who for one reason or another are not being adequately used. His program should soften the shock of the impending serious shortage of trained men.—*Editors*

NUMEROUS forecasts predict a shortage of engineers and scientists available for industrial employment. The drafting of young students for the armed services virtually annihilated the graduating classes from 1942 through 1945. The current return to college will not produce a full volume of employable engineers for another three or four years. Nor will the educational system be graduating a supply of scientists and engineers that will match the industrial demand for some five to seven years. The prewar reservoir of young technically trained manpower is sadly depleted.

Postwar expansion plans further accentuate this shortage. A recent survey reports plans calling for 25 to 75 percent increases over prewar levels in the technical personnel of many large corporations. The corresponding increase in smaller organizations is proportionally greater as might be expected.

One aspect of this scarcity situation that appears to elude both managements and engineers is the nature of the employment market. For the next several years, the scarcity will maintain the sellers' market that developed during the latter months of the war. Clearly the value of knowledge and know-how rides high in this market, carrying the possessors to higher levels. Supply is down. Demand is up. These factors point to the dominance of applicants in a market no longer restrained by WMC regulations.

INDUSTRY CAN DO IT

Industry has the power to improve the value of its engineering resources now. Alert organizations can hardly expect to stop completely the migration of trained personnel following the trend to more satisfying and more remunerative connections. But managements can meet this situation part way if they face the necessity for salvaging those engineers who are already on the payroll.

Those salvageable engineers now suffer from poor morale resulting from a loss of incentive and augmented by frustrations caused by minor irritating work conditions. Although a few of the causes can be traced to the backwash of war's end when "bumpdown" reduced many men from active responsibilities to lower levels of importance, more reasons for discouragements take root in prewar personnel policies.

Another cause breeding discouragement stems from traditional placement policies. Self-sufficient individualists are repeatedly forced to work in teams against their natural inclinations. At the same time team workers, more typically extroverted, are shoved into corners with assignments that they must execute individually without outside help. By keeping both types surrounded by conditions alien to their natural inclinations, the productivity of each slumps due to subconscious emotional reactions. Just as personnel policies have disregarded personalities in making initial placement assignments, so are they further guilty of such practices as ruining creative minds by keeping imaginative people on dulling routine work indefinitely or rewarding plodding routineers with minor supervisory rank simply because they happen to be standing on the escalator of seniority.

All too often is emphasis placed only on acquiring the largest number of subordinates as the measure of rank among supervisors at all levels. Too seldom is any other avenue toward advancement offered except through supervision. All of these factors sap the self-confidence and courage of individual engineers. When many men are infected, then group demoralization sets in, dragging over-all productivity down to low levels. With an enlightened salvage program, many of these engineers can be encouraged to become more useful and more productive, so much so that their increased activity will permit the downward revision in the estimates for replacements. Good salvage can develop more engineering talent without entering a highly competitive market to hire so many new people.

HOW IT CAN BE DONE

A profitable salvage program can start along six lines.

1. Managements can challenge their engineers to adopt the broad over-all viewpoint necessary to operation of an enterprise. Because they think they own keen minds, quick perception, and sharp intuition, engineers ignore the possible help that management training programs can give them. Hence, the engineer in his earlier years of employment fails to develop a sense of proportion about and of the interdependence of his work on the other functional groups. He prematurely shies away from good cooperation before he realizes its importance to his own development. Because managements now lose heavily through the poor development of potential talent, they can well afford to bring this subject sharply to the attention of engineers of all levels who are in a position to assist.

2. The division of work between men professionally trained and those grown up through apprenticeship too seldom is based on the mental requirements of the job. Consequently highly educated young men work on routine type tasks side by side with empirically developed older

(*Continued on page 114*)

JOHN F. HOGERTON *Chemical Engineer, The Kellex Corp., New York, N. Y.*

Oak Ridge Gives Industry a Unit Operation

GAS DIFFUSION

Of all the techniques developed to tailor the atom, the gas diffusion process will undoubtedly contribute most to the chemical industry's stock-in-trade. Although this present account of the so-called K-25 Plant must perforce leave much unsaid, it does reveal enough new engineering information to permit a reasonable evaluation of diffusion as a practical tool. Greatest source of encouragement, perhaps, lies in the evidence that the enormity of the task at Oak Ridge was due primarily, not to anything inherent in the principles or application of the process itself, but to inexperience and to complications peculiar to uranium.—*Editors*

Quite a number of articles on the atomic bomb plants have stressed the contrast between the enormous size of the plant facilities and the extremely small amount of the product. It is not surprising, then, that the question one hears most frequently is, "Why are such large plants required?" By way of answering this, let's look at the K-25 Gas Diffusion Plant, the largest of our three atomic plants. The K-25 Plant, a part of the Clinton Engineer Works at Oak Ridge, was designed and engineered by The Kellex Corp., a special subsidiary of the M. W. Kellogg Co. of New York, and is currently concentrating U-235 on a very considerable scale.

It is interesting to note that, although the principle of gaseous diffusion was known as far back as 1829, the K-25 Plant represents its first commercial application outside the laboratory. Heretofore, materials to be separated have always had sufficiently dissimilar physical or chemical properties to permit the use of better known methods, such as distillation, absorption, or crystallization. So long as such methods were adequate, there was little incentive to take on the formidable problems associated with the diffusion process. The two important isotopes of uranium are such nearly perfect twins, however, that methods comparable to gaseous diffusion had to be resorted to.

But now that details of the process have been worked out, gaseous diffusion is in a position to compete commercially with conventional methods of separating. Engineers have in fact been presented with a new unit operation, and one which accomplishes "impossible" separations.

DIFFUSION IN GENERAL

The heart of the diffusion process is a highly special type of porous membrane, known as the barrier, which contains on the order of hundreds of millions of pores per square inch. It goes without saying that these pores are submicroscopic; indeed their average diameter is estimated at two millionths of an inch. Development of a practical barrier was one of the knottiest problems and one of the most significant achievements of the project.

To understand how the diffusion process works, picture a barrier dividing a chamber into a high and a low pressure zone. If a mixture of light and heavy gases is pumped through the high pressure zone, the fraction which passes, or diffuses, through the barrier into the low pressure zone will be found to be appreciably richer in the light component of the mixture for the reason that the lighter gas, because of the greater mobility of its molecules, tends to pass through the barrier with greater ease than does the heavier, and more ponderous, gas. By the same token, the fraction that did not go through the barrier will be found to be poorer in the light component. The barrier has partially separated the mixture. If the process is repeated enough times, a clean separation can be accomplished.

The extent to which any two gases can be separated in a single stage has been found to be proportional to the square root of the ratio of the molecular weights of the gas molecules; for example, the so-called separation factor of a nitrogen-hydrogen mixture is equal to the square root of 28/2, or 3.75. This means that under ideal conditions the ratio of hydrogen to nitrogen can be increased by a factor of 3.75 in a single diffusion "stage." If the process were carried out on a continuous basis, using five stages connected in series, it would be possible to separate hydrogen of over 99-percent purity from a feed mixture of 30 percent hydrogen and 70 percent nitrogen. Such a system is called a diffusion cascade.

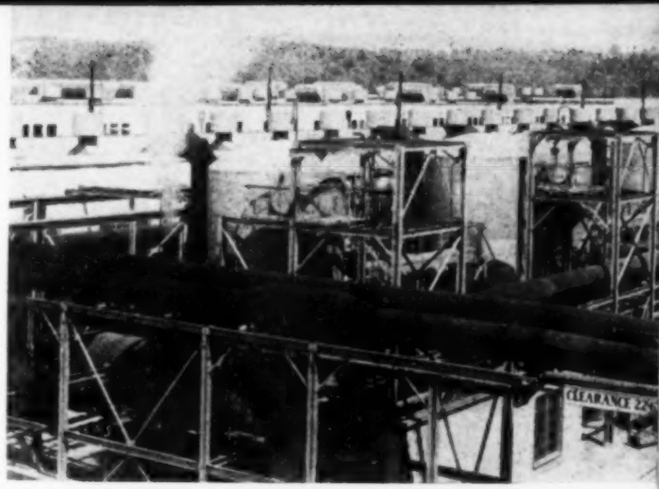
One way of designing a diffusion cascade is to allow half of the stream fed to a given stage to diffuse through the barrier; that half is then directed up the cascade to the next higher stage, while the undiffused half is directed down the cascade to the next lower stage. Under this arrangement each stage is fed with a mixture of the depleted gas from the stage above and the enriched gas from the stage below. The concentration of the light component in the process stream is then progressively higher from the base to the top of the cascade. Generally a number of stripping stages are provided below the base of the cascade to recover some of the light component from the waste stream, the number of stages (i.e., the degree of recovery) being determined by the value of the material.

One of the features of the diffusion process is the amount of gas which must be circulated relative to the amount of gas taken off as product. A little thought will show that most of the gas at the top of the cascade must have been recycled many many times. Where a great many stages are involved, some of the gas is probably recycled millions of times. Hand-in-glove with the recycling idea is the requirement that there be a "net upflow" of light component from stage to stage equivalent to the amount of light component drawn off as product. Since net upflow can be expressed as the interstage flow times the

concentration difference between the "up" and "down" streams, it is apparent that where that concentration difference is small, as when gases of only slightly different molecular weights are being processed, an enormous amount of gas must be processed by each stage. In practical terms, all of this adds up to one thing—pumps! Large cascades call for a great many pumps and for a sizable supply of power to drive them.

Another characteristic of the diffusion process is that it must be carried out at relatively low pressures if it is to be efficient. When the pressures are too high, non-separative mass flow, rather than the desired diffusive flow, will predominate. Pressures around atmospheric are probably low enough for most applications but where the separation factor is small subatmospheric pressures are required, necessitating operation of equipment under partial vacuum. Equally important is that the pressures at each stage be closely controlled. An abnormal pressure condition at any one stage will start pressure waves travelling up or down the cascade which would disrupt the equilibrium of the whole system. Therefore the diffusion cascade must be equipped with extremely reliable devices for controlling flow and pressure.

Although, within limits, temperature has little effect on the diffusion process per se, it too must be carefully controlled. One reason is that temperature changes cause pressure fluctuations. Another and far more important reason is that where corrosive gases are concerned, increased temperatures bring increased corrosion rates. To appreciate how serious this is, one must be familiar with the unique corrosion problems encountered in the diffusion cascade. Over and above corrosion of the equipment and possible failure of parts are the problems of barrier plugging and process gas consumption. The former refers to the plugging of the barrier pores, primarily, by products of corrosion, and to a smaller degree by the accumulation of dusts formed elsewhere in the system. The latter refers to the loss of the desired light component through reaction with plant surfaces. Plugging is serious since it directly affects performance; consumption, because it directly affects the plant yield. Where the gas handled is very corrosive and where there are large areas of metal surfaces involved, it is entirely possible for 100 percent of the product to be consumed. Therefore, in order for the diffusion process to be successful, either the process gas must be non-corrosive or ways must be developed for "conditioning" the plant surfaces against corrosive attack. In either case, each stage of the cascade must be equipped with heat exchangers to remove the heat of compression generated by the circulating pumps and, also, with instruments to control the operating temperature within rather close limits.



Part of dry air plant inside "U" of K-25 Plant

A feature of the diffusion process encountered in few other processes is the so-called equilibrium time. When the cascade is first started up it must be allowed to run undisturbed until the proper concentration gradient has been established at each stage. Then and only then can product be taken off. Establishing equilibrium throughout the system involves a great deal of "separative work" and, depending on the size of the cascade, may take anywhere from a day to several months. Since every cubic foot of internal volume adds to the equilibrium time, it is important to design the cascade with as little volume as practicable. For example, the stage arrangement should be compact in order to minimize the volume of the interstage piping. Similarly, all of the process equipment should be specially designed with a view toward minimum hold-up. In the case of pumps, this means as high speed a machine as possible.

GROWING PAINS

If ever a new process had a "baptism of fire" it was the gas diffusion process, for of all the materials one could conceivably be interested in separating by this means, the uranium isotopes are probably the most obstreperous. To begin with, there is the exceedingly small difference in their molecular weights. One, if not the only, gaseous compound of uranium is hexafluoride, UF_6. Since $U^{235}F_6$ has a molecular weight of 349 and that of $U^{238}F_6$ is 352, the theoretical separation factor is only 1.0043. When one considers that the natural concentration of the 235 isotope is 0.71 percent it is immediately apparent that many hundreds of stages are required to obtain a very highly enriched product. Moreover in actual practice one must contend with imperfect barriers and with operating conditions which deviate from the ideal. Therefore, even more than the theoretical number of stages are required. The K-25 Plant actually contains several thousand diffusion stages and enough barrier to stretch from New York to Tokyo!

From the preceding paragraphs the reader can appreciate that several thousand stages means thousands of diffusion cells, thousands of pumps, thousands of heat exchangers, thousands of valves, thousands of instruments and miles and miles of pipes—all connected into one continuous system! It doesn't require much imagination to picture the kind of problems which must be encountered in designing such a system, particularly when one considers that smooth and uninterrupted operation is absolutely essential to the process. It also serves to explain why a large plant is necessary.

But the number of equipment units and the complexity of the system are only part of the story. Add to these the fact that a cascade processing uranium hexafluoride must be operated at reduced pressures and hence all process equipment must be extremely vacuum tight. Then there is the matter of corrosion. Uranium hexafluoride is one of the most corrosive chemicals known, attacking practically all metals, non-metals, and organics. The problem is further complicated by the fact that even at reduced pressure uranium hexafluoride solidifies at around 100 deg. F. There is thus a balance between the desirability of operating at as low a temperature as possible in order to minimize corrosion and the necessity for keeping above a certain minimum temperature in order to prevent the process gas from solidifying and clogging the apparatus. Still another complicating factor is the highly poisonous nature of uranium hexafluoride. As an example, before process equipment can be opened for repair it is necessary that the uranium hexafluoride content be less than one part per million. Also there is the matter of hazards, for this after all is the stuff of atomic bombs. Needless to say, the most thorough precautions had to be taken against a premature chain reaction.

To summarize then, here are the problems and responsibilities facing Kellex engineers when they began work in January 1943:

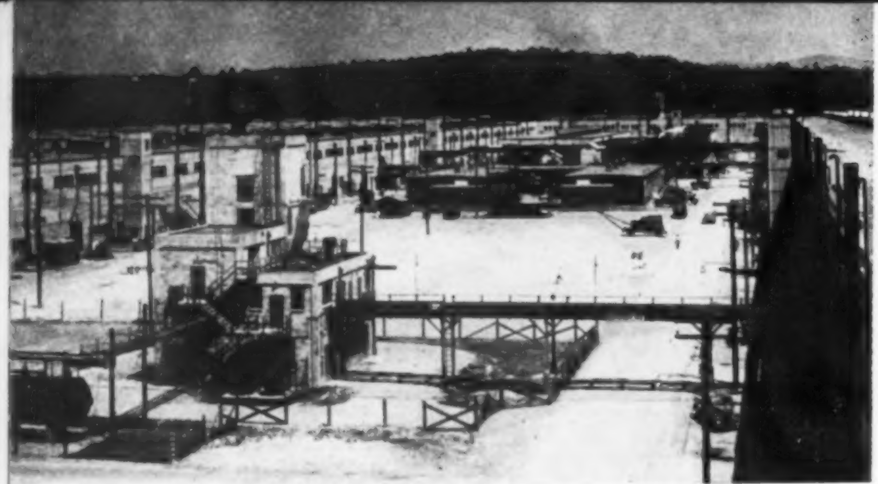
Design the most complex process plant in industrial history on the basis of incomplete laboratory tests.

Engineer this plant under conditions which made it apparent that important decisions would have to be made in the absence of adequate process information.

Plan, schedule, and coordinate the effort of dozens of universities and industrial development agencies as well as the productive facilities of hundreds of equipment manufacturers.

Develop the first barrier and manufacture acres and acres of it to the most rigorous specifications.

Develop and manufacture thousands of high-speed, non-leaking, non-corroding circu-



Inside the "U" at K-25 Plant. Dry-air plant in distance is half mile away

lating pumps, as well as a variety of types of vacuum pump.

Develop and manufacture thousands of special equipment units like diffusion cells and heat exchangers, all of which would have to be vacuum tight and corrosion resistant.

Develop and manufacture thousands of special valves, all vacuum tight and corrosion resistant. (Block valves would be required to have an unprecedented tightness across the seat.)

Develop, fabricate, and assemble hundreds of miles of vacuum-tight pipe, either lined with or constructed of corrosion resistant materials.

Develop and manufacture thousands of special analytical, metering, and control instruments, all vacuum tight and either indirect in action or built of corrosion resistant materials.

Develop and produce sizable quantities of special chemicals for various services.

Develop vacuum techniques and special instruments for leak detection.

Solve unprecedented corrosion problems.

Procure or provide for a large block of power of an exceptionally high dependability factor.

These are but a few of the outstanding items. Substantially every piece of equipment in the process plant is either entirely novel or is a special adaptation of a standard model. To manufacture this special equipment and to supply these special materials, it was often necessary to erect new production facilities, in some cases, sizable plants. No one who has seen this great K-25 Plant rise above one obstacle after another can escape the conviction that very little is impossible.

A barrier was developed of so fine a construction that a square foot panel has several hundred square feet of actual surface; pumps were developed which operate at supersonic velocities; leak detection techniques were perfected which make it possible to manufacture vacuum tight industrial equipment on an assembly line basis; conditioning techniques were developed which make it possible to expose metals to highly corrosive atmospheres with less corrosive effect than when stainless steel is exposed to air; instruments were developed which mark the closest approach to robot control yet realized in an industrial plant; block valves were developed which are an order of magnitude more effective than any previous type; chemicals were developed which represent an entirely new family of chemical formulas.

The story of this development and manufacturing program is a technological epic. A tremendous amount of scientific data which served as a basis for design of the plant was obtained from the S.A.M. Laboratories of Columbia University, where over 1,000 scientists from organizations all over the country worked on the project. That the venture was successful is history.

CLEAN AND TIGHT

In a world that was full of aches and pains there were two in particular which K-25's construction contractors are never likely to forget. One was "cleanliness control" and the other, "vacuum tightness." The former meant that an entire plant had to be as clean as a surgeon's forceps; the latter, that an entire plant had to be built as vacuum tight as a thermos bottle. The need for vacuum tightness is easily understood in the light of the foregoing discussion. It might be explained, however, that extreme cleanliness was one of the steps involved in "conditioning" the process equipment. Both of these requirements presented highly unusual problems to the construction forces.

Taking cleanliness control first, there were two phases to cleanliness; one was getting the equipment clean and the second was keeping it clean during installation. By way of illustrating the degree of cleanliness required, a thumbprint represents contamination in the K-25 sense of the word! To begin with, all process equipment, from individual valves to sub-assemblies of pipe, had to be put through as many as a dozen cleaning operations, including sandblasting, degreasing, alkaline cleaning, acid pickling and surface passivation. After cleaning, the equipment was dried and then tightly capped to prevent contamination during handling. Certain equipment items were pressured with dry nitrogen to preclude any possibility of moisture infiltration. Once cleaned, dried and capped, the equipment was subject to the procedure known as cleanliness control. The first step in cleanliness control was to partition off the building in which the equipment was to be installed. This done, the building was thoroughly cleaned from roof to basement, and in that order. Not only was all construction debris cleared away, but all building surfaces, even to the ceilings, were wiped down by hand or vacuum cleaned. Once the building was clean, elaborate precautions were taken to keep it clean. To mention a few: the building was placed under forced draft ventilation and all air was filtered; only essential trucks were permitted to enter the building and these were hosed down; workers were admitted only after they had brushed their clothes. All things considered, the K-25 cleanliness control program is thought to be one of the most unique activities ever encountered on a construction project.

Vacuum tightness presented an entirely different kind of problem. Here it was necessary to develop more than a dozen welding techniques, as well as techniques for locating and repairing the most minute leaks. To illustrate the degree of tightness required, the broad specification for the process systems is that the pressure rise due to inleakage must be less than 0.02 cm. of mercury (0.004 psi.) per day. The problem was complicated by the variety of different metals encountered in the system and by the many hundreds of miles of welding required. As many as 1,200 welding machines were in use at one time. Both pressure and vacuum testing were brought into play in testing the installations. The former was used for locating gross leaks, and the latter, for locating small leaks and for measuring final tightness. An ingenious vacuum testing technique, developed at the Univ. of Minnesota and in Kellex laboratories, was used with signal success. In this method the equipment under test is continuously evacuated by a high speed pump, while the suspected areas are probed with a special gas. Traces of the gas in the exhaust gases are thus an indication of a leak. The apparatus which detects the presence of the gas is tuned to give an instantaneous response, so that it is possible to probe a fairly large area in a relatively short time. Without this rapid and powerful means of leak detection, the K-25 Plant could never have been completed on time. No one has ever counted the number of leak tests which were made during the construction of the K-25 Plant, but it is certain that they exceeded one million. Over 1,100 persons were engaged in this work.

Other unusual construction problems encountered in building the K-25 Plant were, at random: the erection of the airtight stage inclosures, which involved nearly 1,000 miles of airtight welding and which engaged as many as 400 sheet metal workers at one time; the installation of 3,800 miles of electrical conductors and 825 miles of electrical conduits, which involved more than 90,000 separate tests

on electrical systems; the installation of thousands of precision instruments, involving 4,000,000 ft. of copper tubing and 1,000,000 ft. of copper wire.

PLANT LAYOUT

The K-25 Plant exists on paper as 20,000 pages of specifications, 12,000 separate construction drawings and 10,000 pages of operating instructions. It exists in reality as a massive array of buildings in the northwest corner of the Clinton Reservation.

Most impressive of the structures is the "U." This is a huge U-shaped chain of buildings which contain the diffusion cascade and related equipment. Four stories high, over a mile long, and nearly a quarter mile across, the "U" encompasses an area of 60 acres. The structural material is reinforced concrete up to the main level, and steel frame and transite siding from there to the roof. The first level is occupied by auxiliary equipment, transformers and electrical switchgear, ventilating fans, and duct work. The second, and main, level carries the diffusion stages which are completely inclosed by welded steel panels. The third level is a pipe gallery which carries the main process headers as well as a variety of auxiliary pipe lines. The process headers, like the stages, are inclosed by steel panels. It is of interest to note that a special atmosphere is maintained inside these inclosures, the total volume of which exceeds 6,000,000 cu.ft. The fourth level is the operating floor. Here are installed the hundreds of instrument panel boards and control devices for operating the cascade. All section bypass valves extend through the operating floor where they can be manipulated by the operators. In a central location on the operating floor is a master control room equipped with instruments which make it possible to scan the operations over the entire cascade. From this central station one can set in motion the robot controls for isolating sections of the cascade from the main process stream.

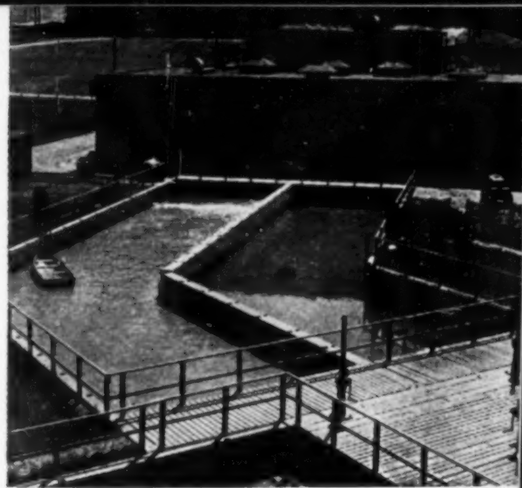
More than 200,000 cu.yd. of concrete and 30,000 tons of structural steel went into the building of the "U." An interesting fact in connection with its construction is that it was built on "compacted fill," which up until that time had not been used extensively in building construction. If the usual procedure of leveling the site had been employed, a great proportion of the filled areas would have been unsuitable for carrying the foundation loads. On the other hand, carrying footings down to virgin soil would have required several thousand columns of different lengths, the design and setting of which would have entailed an enormous amount of time. Compacted fill, though it required careful control of the moisture content of the soil, offered the advantage that standard columns could be placed directly on the fill. Although carried out during a period of unusually heavy rainfall, this method of soil preparation proved entirely satisfactory and saved countless man-hours of construction labor. All in all, 2,000,000 cu.yd. of fill were so prepared.

Located in the center of the "U" are a number of auxiliary plants, not the least of which is the largest air drying installation ever built; and northwest of the "U" is one of the largest spray cooling tower installations ever built. The latter is part of a recirculating cooling water system which handles enough water to supply a city of five million. The primary function of the cooling water system is to remove the waste heat from the process. This, incidentally, is not as simple as it sounds. It is imperative that "no" water find its way into the process system. Since, no matter how reliable their construction, there is always the possibility of a leak in the stage heat exchangers, water cannot be used as the cooling medium. It was therefore necessary to develop an inert chemical for this service. Special coolants were developed in collaboration with Johns Hopkins and other universities. The coolant removes the heat from the process gas and is then in turn cooled by heat exchange with water in a system so designed that if there is a leak it will be from the coolant to the water, rather than vice versa. It may be of interest that the plant's inventory of special coolant is valued at $20,000,000.

East of the "U" is the conditioning area, a large scale plant in itself. The heart of this area is the conditioning building, wherein process equipment is "conditioned" for service in the diffusion cascade. A steel frame and brick wall structure, 1,000 ft. long by 400 ft. wide, the conditioning building may be likened to a vast chemical and mechanical workshop. It is made up of a series of disconnected areas, at least one of which fairly bristles with special equipment. Scattered around the conditioning building are a number of satellite installations, including several chemical plants.

South of the conditioning area is the administration area, essentially cafeterias, office buildings, hospital, and work laboratories. There are four laboratories, three of concrete block and one of wood frame construction, and they contain an impressive array of apparatus. One of their notable features is an air conditioning system which maintains the temperature within 0.2 deg. and the humidity within comparable limits.

Approximately one mile south and west of the "U" is the K-25 power plant which generates much of the power consumed by the K-25 Plant. The largest single steam-electric station ever built at one time, the power plant has a capacity of 238,000 kw. There are three 750,000-lb.-per-hr., pulverized coal fired boilers which supply steam at 1,325 psi. and 935 deg. F. to a bank of 14 turbogenerators. Ranging in capacity from 1,500 to 35,000 kw., some of these units are air and some hydrogen cooled. One of the features of the power plant is an unusual recirculating water system handling a quarter million gal. per min.



Huge flumes linking cooling towers

Naturally, a plant the size of K-25 has a great many yard facilities. In addition to sanitary water and sewage plants, there are something like one hundred miscellaneous warehouses, field offices, guard stations, bus terminals, garages, and labor camps which accommodated 12,000 construction workers. The whole is knit together by approximately a hundred miles of road. There is also a railroad system comprising 20 miles of spur track, which connects with the Southern Railroad station at Blair Siding, sixteen miles away. By the summer of 1945 this railroad system had handled more than 55,000 carloads of materials and equipment.

Such is the K-25 Plant, built in its entirety on an undeveloped and remote site in barely two years time. This nearly miraculous construction task was accomplished by the J. A. Jones Construction Co. and by Ford, Bacon & Davis, Inc. as management contractors, with The Kellex Corp. acting as supervisor of construction. The former construction company built the process plant, administration area, power plant, and yard facilities; the latter, the conditioning plant.

Some idea of the scale of the construction activities in the K-25 area is given by the fact that the peak construction force exceeded 24,000.

Some idea of the speed with which the work progressed is found in the construction of the power plant. Ground was broken at the power house site on the first of June 1943. The first boiler received its dry fire on March 9, 1944; and the first turbine was placed in service on April 15, 1944. In other words, this giant installation was actually generating power barely ten months after the breaking of ground. Very little, to repeat an earlier statement, is impossible.

M. C. FOX *Lt. Col., Manhattan Engineer Project, Oak Ridge, Tenn.*

THERMAL DIFFUSION

As Adjunct of Electromagnetic Process

Deep beneath the deluge of publicity on the four Atomic Giants —the Hanford pile, the gas diffusion process, the electromagnetic process, and the Los Alamos laboratory — there lies buried and obscure a fifth member of the fraternity, the thermal diffusion process developed by Dr. P. H. Abelson of the Naval Research Laboratories. Because of its relatively small size there has been little said about it, but it added much to the success of the over-all project.—*Editors*

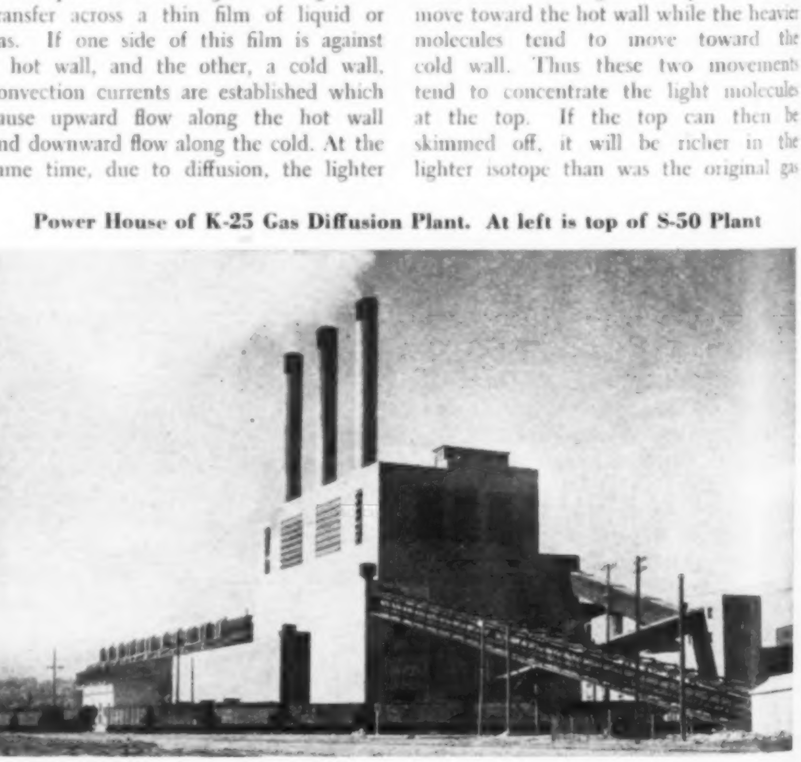
S-50 Thermal Diffusion Plant and its small auxiliary power plant (left)

It would be no great exaggeration to call the S-50 Thermal Diffusion Plant a child of desperation. To understand the frantic haste with which it was erected, one must remember that there was a period of about a year when the electromagnetic plant was the only one in operation for separating the uranium isotopes. The pressure to bolster its capacity is not hard to imagine.

One way to increase production would be to increase the percentage of U-235 in the uranium feed. Natural uranium contains only 0.7 percent U-235; if feed material were provided which contained 1.4 percent there would be a proportionate gain in the output. At it happened, work with the thermal diffusion process had shown that this process works most efficiently when producing a slightly enriched product. Moreover, considerable quantities of 1.4 percent material had been produced. This degree of enrichment was sufficient to justify adoption of thermal diffusion as a preliminary to electromagnetic separation. Consequently, in June 1944 the H. K. Ferguson Co. was instructed to proceed with the design and construction of the S-50 Plant at Oak Ridge.

The process itself hinges on a high heat transfer across a thin film of liquid or gas. If one side of this film is against a hot wall, and the other, a cold wall, convection currents are established which cause upward flow along the hot wall and downward flow along the cold. At the same time, due to diffusion, the lighter molecules of the gas or liquid tend to move toward the hot wall while the heavier molecules tend to move toward the cold wall. Thus these two movements tend to concentrate the light molecules at the top. If the top can then be skimmed off, it will be richer in the lighter isotope than was the original gas

Power House of K-25 Gas Diffusion Plant. At left is top of S-50 Plant



or liquid, while the residue will be depleted in light molecules and enriched in the heavy. Theoretically, if this process were repeated enough times, isotopes could be completely separated.

CONCENTRIC COLUMNS

The situation just described is obtained mechanically by building columns consisting of three concentric pipes. The inside pipe is a steam line; saturated steam enters at the top and condenses as it flows toward the bottom. In the annulus between this inside pipe and the second pipe is the material to be processed, uranium hexafluoride. Cooling water flows in the large outside annulus between the second pipe and a 4-in. iron casting. Each column acts as an individual unit although a group of columns are usually operated in parallel. In operation, condensing steam liberates heat which is transmitted through the film of liquid or gaseous uranium compound. The inner wall is hot and the outer, relatively cold. As U-235 molecules diffuse toward the hot wall they are carried upward by convection and are skimmed off at the top. Depleted uranium compound is taken off at the bottom.

Construction of the columns presented the first serious problem. Twenty-three major manufacturers were contacted and all twenty-three separately agreed that it was not possible to make them on a production basis. Finally, the Mehring and Hanson Co. of Washington, D. C., and the Grinell Co. of Warren, Ohio, agreed to try and subsequently succeeded. The exacting tolerances necessary to avoid parasitic currents required machining accuracies not ordinarily encountered. In order to provide absolute tightness, the inner pipe had to be welded to the middle pipe, top and bottom; the stability of this assembly was tested at 4,000 psi. Materials of construction had to withstand not only the corrosiveness of uranium hexafluoride, but also the tremendous stresses set up in bringing the column from room temperature to a condition where the outer pipe is cool and the inner one is hot.

Another troublemaker was the necessity for de-superheating the steam which was obtained from the power house of the K-25 Plant, since saturated steam was required and the power house furnished superheated steam for driving turbines. This was done by pumping hot condensate from the columns through jets in the steam header, thereby increasing the volume of steam and at the same time reducing its temperature and pressure. To get accurate control the last jet was installed in a venturi.

A novel item of equipment was a pump which the Pacific Pump Co. had been using to pump hot oil in Persia and which was adapted by them to service in this plant. Three of these complexities, known as "silver queens," were built and installed.

One particularly difficult problem involved maintaining a constant condensate level in the columns. It is easy to see that condensing steam must be present all along the column, else variable temperatures will disturb the delicate process currents. The condensate must be taken away exactly as it is made—not too fast, or steam will just blow through the column, and not too slowly, or condensate will back up and cool the process. The float control for this job was developed by the Swartwout Co. of Cleveland.

A fair estimate of the procurement problem is reflected in some of the orders that were placed: 42 10,000-gpm. centrifugal pumps and 4 15,000-gpm. vertical turbine pumps from Pacific Pump Co.; 42 100-hp. motors and 4 700-hp. motors from Westinghouse; almost 15,000 valves varying in size from ½ in. to 54 in. and from low pressure water to high pressure steam; 50 miles of nickel tubing and almost 20 miles of 4-in. pipe. We still marvel that everything arrived on time.

When construction neared completion the Ferguson Co. formed a wholly owned subsidiary, The Fercleve Corp., to operate the plant. As construction forces moved out, the operators moved in, conditioned the columns and piping, and started to operate the plant. The first unit was conditioned on Sept. 17, 1944, just 66 days after breaking ground and 83 days after the Ferguson Co. was told to take on the job. Even in a program where construction miracles were expected, the S-50 Plant was spectacular. Without question it represents the fastest construction project in the entire record of the Manhattan Engineer District.

How to Choose, Install and Protect Chlorination Equipment

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BECAUSE of its low price, its ready availability in peacetime, and its reactivity, chlorine gas is a "natural" for many industrial chemical operations.

Every chemist and chemical engineer knows that chlorine combines readily with many other materials. It unites with cold powdered antimony in an addition reaction to form antimony trichloride; it also combines with hydrogen—a jet of hydrogen burns vigorously in chlorine—to produce hydrogen chloride. Other chemicals are displaced by chlorine. In its reaction with turpentine, it displaces carbon. The well-known iodine test is another displacement reaction, a trace of chlorine displacing the iodine in potassium iodide and giving a deep blue color to the starch.

Other types of chlorine reactions include decomposition, dissociation, double decomposition, internal rearrangement, oxidation, reduction and electrolysis.

During the war, plant capacity for chlorine production in the United States was more than doubled, to meet the increased need for chlorine in old and new applications. Many of these applications require the direct use of chlorine gas and it is therefore important for operating chemical engineers to be familiar with the best and safest ways of installing, operating, and maintaining chlorination equipment.

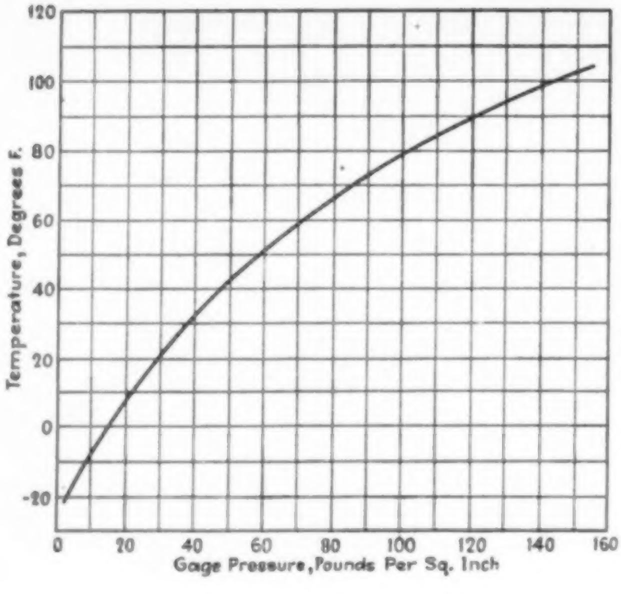
When a new chlorination process is to be installed the first question that occurs to the operating engineer is: What is the best way to attain accurate gas flow regulation under actual operating conditions? In its simplest terms this question is answered by the proper combination of the following items of equipment:

1. An auxiliary valve attached to the chlorine cylinder, which facilitates replacement of cylinders without gas leakage.
2. An automatic pressure-reducing valve of the required accuracy, having its gas-exposed parts made of metals which resist hypochlorous and hydrochloric acid corrosion.
3. A diaphragm-protected pressure gage to indicate the low-side pressure.
4. A suitable filter to pick up gum and other impurities, thereby protecting the rotameter or other flow-measuring device.
5. A flow meter, such as a rotameter, calibrated to measure the required rate of gas flow under standard conditions of temperature and pressure.
6. A corrosion-resistant needle valve sufficiently delicate in operation to allow accurate setting of the flow rate.

A number of manufacturers (i.e., Wallace & Tiernan Co., Everson Mfg. Co., and Chemical Equipment Co.) sell standardized units comprising the above items of equipment. These manufacturers have developed pressure chlorinators and other gas flow regulators to a high state of accuracy and dependability, particularly for use in the water purification field.

Equipment of this type should be connected with silver tubing, as this will resist corrosion and minimize gum formation.

The statement is sometimes made that



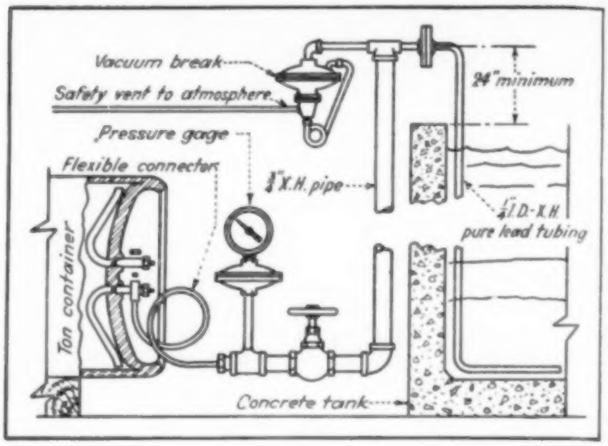


Fig. 1—Temperature-pressure curve for liquid chlorine

Fig. 2—How to connect vacuum-break when chlorine container is below the level of liquid being treated

dry chlorine will not attack iron and other metals which are corroded rapidly by (wet) chlorine. This is true, for chlorine is shipped and stored in steel cylinders and tank cars with perfect safety. In many industrial operations, chlorine is dependent upon the presence of moisture in order that it may react. For example, if dry colored cloth is hung for several days in an atmosphere of chlorine gas dried by sulphuric acid, little or no change will take place; but, if the same colored cloth is wet, it is bleached as soon as the chlorine has dissolved in the water to form the powerful bleaching agent, hypochlorous acid.

Once chlorine gas leaves the cylinder or tank car in which it was shipped from the manufacturer's plant, it is difficult to insure that it will remain free from moisture. As a result, chlorinating systems which contain iron pipe are subject to excessive gum trouble. In such systems, a large proportion of the troublesome deposit is found to consist of ferrous and ferric chlorides, products of the reactions between hydrochloric acid, hypochlorous acid and iron. An obvious remedy, therefore, for reducing gummy deposits in chlorination systems is to avoid the use of iron in parts and piping with which the chlorine comes in contact.

REVERSAL OF FLOW

Solubility of chlorine in water and other liquids can, under certain conditions, lead to reversal of flow, or "suck-back." That is, the solution being chlorinated will be drawn back to the lines, valves, or chlorine container.

Normally, the flow of liquid or gaseous chlorine will continue through the feed line into the solution or slurry which is being treated while the valve is open and the chlorine pressure in the cylinder exceeds the back-pressure in the treating tank. When the pressure in the cylinder drops below the back-pressure (or the pressure due to the head of liquid in the treating tank) reverse flow will take place if the valve is still open.

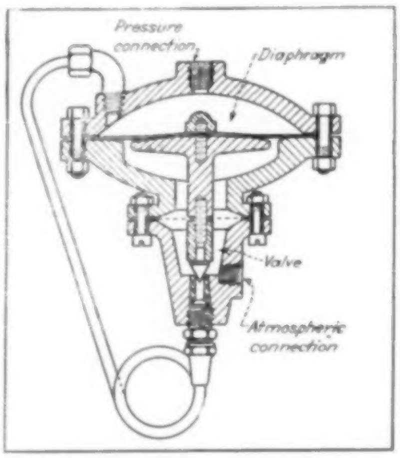


Fig. 3 — Internal construction of Mathieson automatic vacuum-break

The vapor pressure in the cylinder is dependent upon the temperature of the liquid chlorine. Vapor pressures of chlorine gas at various temperatures are shown in the accompanying curve, Fig. 1. The pressure will become very low when there is only gaseous chlorine left in the cylinder. Or, if the chlorine is being fed very rapidly, the rapid evaporation of the liquid chlorine within the cylinder may cause the temperature to fall, so that the cylinder pressure will become sub-atmospheric. In either case, when the pressure in the cylinder falls below the pressure in the treating tank, the flow will be reversed.

Reversal of flow is undesirable, both from the standpoint of corrosion and gumming of chlorination equipment, and because of possible contamination of the product upon resumption of normal gas flow. There is also the danger that some suck-back into the cylinder may take place before all the chlorine has been used, resulting in excessive corrosion of the cylinder.

AUTOMATIC VACUUM-BREAK

This reversal of flow may best be prevented through the use of an automatic vacuum-break connected as in Fig. 2 by means of a tee offset from the chlorine flow-line. Similar arrangements may be used when the chlorine cylinder is above the level of liquid in the treating tank; or when an aspirator ejector is used to control the chlorine flow. Such equipment (manufactured by the Mathieson Alkali Works) has an advantage over an ordinary check valve in the line in that the chlorine gas is sealed off from the valve seat and stem by a silver diaphragm, so that there can be no gum formation to interfere with a tight seal.

In its closed position Fig. 3 shows that the vacuum-break is a "dead end." Under equilibrium conditions, the valve remains closed because of the spring force of the diaphragm. Pressure in the upper chamber, due to chlorine flow in the line, increases the downward force on the diaphragm, and helps to maintain the valve in a closed position.

The chamber beneath the diaphragm is always open to the atmosphere. Consequently, any drop below atmospheric pressure in the feed line caused by gas contraction will immediately result in the pressure beneath the diaphragm exceeding the pressure above it, so acting to open the valve. Thus, before the chlorinated liquid can back up to any considerable extent, air will enter the line, breaking the vacuum, and the solution in the diffusion pipe will return to the normal liquid level.

Chlorination equipment of the type described, properly installed and maintained in clean condition, can give long periods of trouble-free service.

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NEW PELLET DRYER

For TCC Catalyst Offers Diverse Postwar Uses

Undoubtedly there were many wartime equipment developments brought out to meet special emergencies which will have important postwar uses. Such a development was the pellet dryer for TCC cracking catalyst that was rushed through from conception to completion in less than four months to permit the enormous TCC cracking program to go on stream as planned. From the simplicity and low cost of the equipment, and the results achieved, it would appear that dryers of this type are well adapted to the handling of many granular materials, both for drying and for contacting, heating and cooling.—*Editors*

From time to time many interesting and useful types of equipment will be disclosed, undoubtedly, which have been developed to meet emergencies created by wartime conditions. One such emergency developed in the petroleum industry early in the summer of 1943 in connection with the supply of pelleted cracking catalyst to be used in the TCC catalytic cracking process for the production of aviation gasoline.

When the United States became involved in the war, the petroleum industry was called upon to supply to the armed forces unprecedented quantities of aviation gasoline, and the TCC process was scheduled to supply a large proportion of the 100 octane aviation base stock, as well as butylenes, for aviation alkylate and for the rubber program. In the spring of 1943 there were in various stages of construction 29 TCC units with a total cracking capacity of over 300,000 bbl. per day. The first four of these units were scheduled to go into operation in the latter part of August, with other units to follow in rapid succession.

The catalyst fillage requirements of the units averaged about 400 tons per unit, and the makeup requirements of catalyst (of satisfactory hardness index) were estimated to be about 1½ to 2 tons per unit per day. This tremendous demand for pelleted catalyst necessitated considerable expansion of the producing facilities of the Filtrol Corp., supplier of the activated clay catalyst. The Filtrol Corp. was unable to procure and get into operation pelleting and drying equipment in time to meet the early fillage demands of the TCC units.

It is the purpose of this paper to disclose the measures adopted for meeting the emergency and to describe a new type of dryer* which was developed for drying the pelleted catalyst.

An arrangement was made with the Attapulgus Clay Co. to attempt to produce pelleted catalyst in the company's Attapulgus, Ga., plant. This equipment normally is employed to produce Type "AA" fullers earth. Enough of the company's customers agreed to accept the old Type "A" natural granulated fullers earth during the emergency to release sufficient equipment for catalyst production. It was established early in 1943 that the Attapulgus extruding equipment was satisfactory for catalyst production, but all attempts to dry the extruded pellets (containing 45 percent by weight of water) in the existing rotary dryers met with complete failure. Either the catalyst was discharged from the dryers in the form of broken pellets and granules unsatisfactory for TCC units, or the throughput was so small as to be insignificant.

By the end of April 1943 it became evident that large capacity emergency catalyst drying equipment had to be obtained on extremely short notice if the TCC units were to have sufficient catalyst to go on stream when completed. At that time it was decided among Socony-Vacuum Oil Co.; the Filtrol Corp., and the Attapulgus Clay Co. that a new approach to catalyst drying should be made.

STARTING DRYER DESIGN

The process development engineers of the research and development laboratories of Socony-Vacuum Oil Co., at Paulsboro, N. J., had previously made studies of similar problems in connection with the design of Thermofor kilns and the Thermofor Catalytic Cracking (TCC) process which involved many fundamental handling problems similar to those met in a dryer. Hence, they were able to propose practical dryer designs for immediate consideration. Obviously, since the problem was of such importance to the war program, it was necessary to minimize the risk of failure by undertaking an immediate pilot plant development program to parallel a commercial design program.

The approach to the problem was predicated upon the assumption that the commercial dryer would have to be one that could be constructed quickly of non-critical, readily available material. The Socony-Vacuum development engineers, therefore, made their design on this basis, using wood as the principal construction material for the dryer proper, and readily available low-pressure blowers for moving heated air for drying. The drying principle under consideration contemplated flowing undried pellets by gravity in solid columns down through screen-walled cells through which heated air would be blown. Early in May 1943, one of these engineers went to the Attapulgus, Ga., plant of the Attapulgus Clay Co. (extruded, undried pellets being available there) to supervise the construction and testing of a pilot unit. It was possible to erect this unit in a few days and after a brief period of operation it was established that pellets of satisfactory hardness could be produced at good throughput rates. Once this was proven, further tests were made to establish operating conditions for the commercial design.

Additional detailed commercial design

* Applications for U. S. patents have been made on this new dryer developed by Socony-Vacuum Oil Co., and it will be the policy of the company to make the development available to industry on reasonable terms.

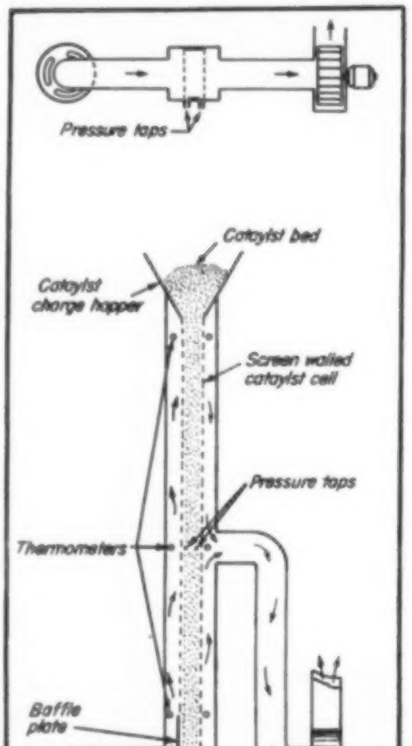


Fig. 1—Pilot dryer for catalyst pellets, built in May 1943

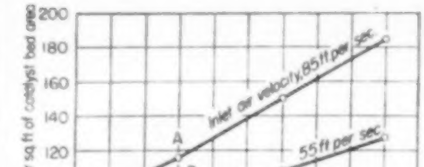


Fig. 2—How air distributes, with and without baffles, in the dryer

data were obtained—particularly on air flow—in cell models constructed at the Socony-Vacuum research and development laboratories. Following this, in cooperation with The Lummus Co., the design of a commercial dryer with a capacity of 100 tons per day of dried catalyst was developed. The commercial dryer was constructed and installed by The Lummus Co. at the Jackson, Miss., plant of the Filtrol Corp., and was operating at rated capacity on August 23, 1943. The dryer was built at Jackson, Miss., because that location was best suited to Filtrol's overall catalyst manufacturing program, although it involved shipping large quantities of wet catalyst, pelleted at Attapulgus, Ga., to Jackson for drying. The same dryer was also used later for drying pellets made in the Jackson plant and when the emergency passed the Attapulgus operation was stopped.

A description of the pilot unit and of the 100-ton per day commercial unit follows:

As shown in Fig. 1 the pilot unit was built with a single screen-walled vertical catalyst cell, 4 in. thick, 10 in. wide and 8 ft. long. Undried pellets from the plant extruder were charged to a hopper above the catalyst cell and were discharged at the bottom of the unit. The catalyst cell was constructed to provide a 3-in. air space between the cell walls and the sides of the unit. Drying was accomplished with air heated by a gas-fired line burner. The air passed transversely through the screen-walled catalyst cell and was discharged through a blower to the atmosphere. Temperatures of the inlet and outlet gases were read at the top, center and bottom of the catalyst cell by means of thermometers placed in the 3-in. air spaces on both sides of the catalyst cell. Pitot tube measurements of the gas rate were taken in the 6-in. diameter inlet gas duct leading to the bottom of the unit. A solid plate baffle covered the catalyst cell at the bottom of the unit to prevent the high-velocity inlet gases from impinging directly on the catalyst bed.

A sufficient number of experimental runs was made on this unit to establish that pellets of satisfactory hardness could be produced in this way, and also to determine optimum operating conditions. The experimental results showed that to obtain maximum hardness it was necessary to dry the catalyst at a slow rate, using relatively low-temperature air. This type of operation necessitates the use of very large volumes of air. Illustrative experimental data are presented in the accompanying tabulation.

FULL SCALE CALCULATIONS

From these experimental data it was established that about 330,000 std. cu. ft. per min. of air would be required to dry 100 tons of pellets per day. Inasmuch as only low pressure blowers (3 in. water) were available, the maximum allowable pressure drop through the catalyst cell was limited to about ¾ in. of water which in turn limited the maximum cell thickness to 4 in. Studies of the relationship between pressure drop, air flow, and air temperature drop to give pellets of satisfactory hardness showed that the area required for transverse air flow through the cell was about 3,300 sq. ft. Also to stay within the allowable pressure drop permitted by the available blowers when using a 10 ft deep cell, the width of the air spaces between the cells could not be less than 8 in. With this size air space between the cells, the velocity head of the inlet air is such that the greatest quantity of air would flow through the catalyst at the downstream end of the cell. To obtain uniform drying of the pellets throughout each cell, the air flowing transversely through the cell must be uniformly distributed.

To determine the most satisfactory design for eliminating this unequal air distribution several cell models were constructed and experiments were made using various air target baffle arrangements for neutralizing the effect of velocity head. These studies showed that three baffles 2, 4, and 6 in. wide, and of the same length as the cells, spaced 2½, 5, and 7½ ft., respectively, from the air inlet end of the cell would provide the required uniform air distribution. The effect of the inlet air velocity on the air distribution through the cells without baffles, and also the distribution with the above baffle arrangement, is shown in Fig. 2.

In order to avoid excessive dryer height and excessive depth which would entail high inlet air velocities, it was decided to construct the dryer as a duplex unit, each half being 10 ft. square by 18 ft. high. The dryer is continuously charged with catalyst from a common elevator and discharged to a common conveyor. Drying is accomplished with a mixture of Dutch oven flue gas and air which is passed transversely through the screen-walled catalyst cells and discharged through blowers to the atmosphere. The inlet air passages of the two drying units are divided into two vertical sections about 9 ft. in length with separate air ducts leading to each section. This arrangement is desired so that the pellets may be initially dried at a low temperature and the air temperature increased as the drying progresses. The air ducts leading to and from the dryer are of about the same cross sectional area as the total cross sectional area of the air spaces between the catalyst cells. These

Effect of Air Temperature and Drying Rate on Hardness of Dried Pellets

Run Number	Average Air Temp., Deg. F. In	Average Air Temp., Deg. F. Out	Temp. Drop of Air Through Dryer, Deg. F.	Air Rate per Sq. Ft. of Catalyst Cell Area, Std. Cu. Ft. per Min.	Residence Time of Pellets in Dryer, Hr.	Hardness Index of Dried Pellets
4	147	92	55	108	1.1	37
5	119	89	30	108	2.2	59
6	104	92	12	108	4.1	75
1	165	94	71	51	2.7	37
2	148	103	45	90	2.7	48

large air ducts are used to permit the passage of tremendous volumes of air with very low pressure drop. In the dryer as installed approximately 336,000 cu. ft. per min. of air is employed, with a pressure differential across the blowers of only 2.5 in. of water.

For successful operation of a dryer of this type it is necessary that the downward flow of material to be dried be uniform over the total cross section of the dryer. This was accomplished by installing in the bottom of each half of the dryer an even-flow baffle system in which all of the material from either half is converged to a single draw-off control valve.

The even flow baffle system consists of a number of plates containing holes. The top plate contains a large number of holes through which the catalyst flows and converges to the plate below, which contains only a fraction of the number of holes in the plate above. This convergence is repeated until all of the material is discharged from a single outlet. The arrangement of the holes in the baffle plates is such that when material is discharged through the control valve, uniform quantities are drawn from each hole in the top baffle plate and uniform flow of the catalyst mass is established at a distance of a few inches above the top plate. This insures uniformity of catalyst flow throughout the dryer. This type of baffle system was developed for use in TCC units and has been described by Newton, Dunham, and Simpson (*Oil & Gas J.*, **44**, June 2, 1945, p. 84).

A diagrammatic sketch of the commercial dryer appears in Fig 3. This dryer was on stream and producing pellet catalyst of satisfactory hardness at design capacity in less than four months after it was decided to develop a dryer of this type.

Very few data have been presented in this paper on the fundamentals of drying pelleted catalyst because of the very limited interest in this particular material. However, we feel that this type of equipment will have a wide field of usefulness in drying or contacting gases with any granular, free-flowing material. The only limitations to its usefulness are that the particle size of the material be such that appreciable quantities of gases can be passed through thin beds without excessive pressure drop, and that the nature of the material being processed be such that it flows freely. Several applications which come to mind where equipment of this type might be desirable are: contacting air with adsorbents for dehumidifying or air conditioning, drying grain, dehydrating foodstuffs, drying granular materials of the chemical and related industries, and preheating granular materials for processing at high temperature. The only temperature limitations of this type of equipment depend upon the material of construction.

HEAT SUPPLY VERSATILITY

In the dryer for pelleted catalyst the air was passed through the catalyst bed once and discharged to the atmosphere. However, for fuel economy or process control the gases could be recycled. Also, by the proper routing of the gas in the unit to give multiple pass contact, countercurrent operation may be accomplished. In the commercial catalyst dryer heat is supplied by simple Dutch ovens in which the fuel is burned and the hot flue gases are discharged into the incoming air stream. However, it is obvious that many other heating schemes would be practicable. This type of equipment is also suitable for cooling materials and lends itself to heat recovery in processes where it is desirable to preheat gases.

It will be noted that in drying pelleted catalyst it is necessary to use about 330,000 std. cu. ft. per min. of air to produce 100 tons of dried catalyst per day. This is because only about a 15 deg. F. drop in temperature of the air passing through the unit can be tolerated. However, for the same drying load, when processing material which does not require such delicacy, the capacity of this size dryer could be increased many fold. Conversely, for processing the same quantity of material, the size of the unit could be reduced proportionately.

In the catalyst dryer, the retaining walls for the pellets consisted of 6-mesh rat screen stapled to vertical 1 by 4-in. wooden spacers at 1-ft. intervals. The mesh of the screen retaining wall is determined by the size of the material being processed. A louvered venetian blind type of retaining wall is entirely satisfactory, the spacing and arrangement of the slats being dictated by the angle of repose of the material being processed.

The relationship between pressure drop, particle size and air rate for the flow of air at atmospheric conditions through granular materials is shown in Fig. 4. Comprehensive treatments of the above relationships have been presented in the literature, for example, Newton et al, above; Chilton & Colburn (*Ind. Eng. Chem.*, **23**, 1931, p. 913); and Allen (*Pet. Refiner*, **23**, 1944, p. 247).

Not only has the dryer described the desirable features of simplicity and low construction and maintenance cost, but it also affords continuous intimate contact between the material being processed and the treating gases.

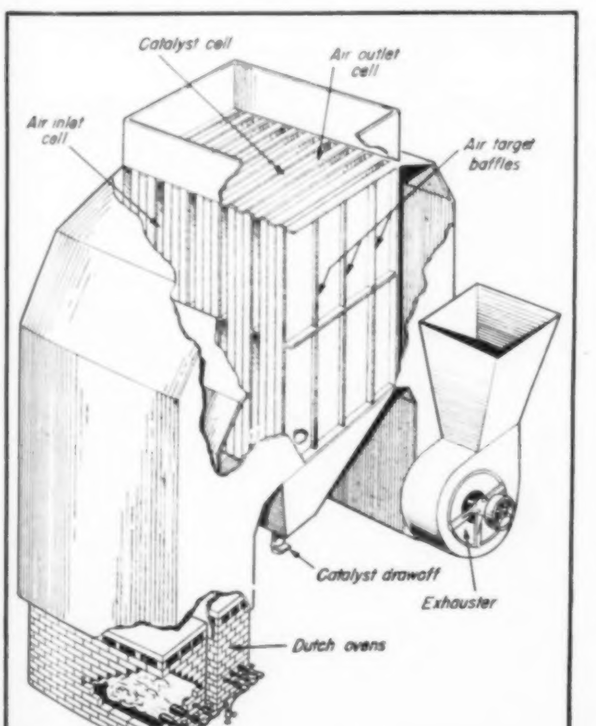
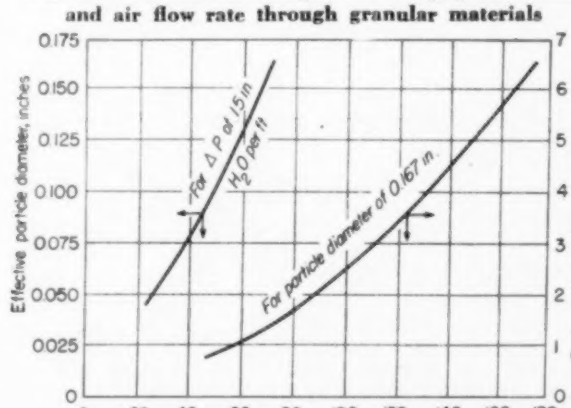


Fig. 3 — This sketch shows the construction used for half the commercial pellet dryer installed at Jackson, Miss.: it was ready for operation in August 1943

Fig. 4—Relation between pressure drop, particle size and air flow rate through granular materials



JOHN R. CALLAHAM *Pacific Coast Editor, Chemical & Metallurgical Engineering, San Francisco, Calif.*

ALUMINA

Produced From Northwest Clay

Feasibility of economic production of alumina from clay by the Chemico process is being tested in an experimental plant at Salem, Ore., sponsored by Columbia Metals Corp. and originally financed by DPC. The process, using ammonium bisulphate digestion to break down the clay, is one of four methods chosen by government technologists for demonstration production of alumina from alumina clays and low grade bauxite. This article outlines basic steps before any modification by pilot plant experience.—*Editors*

One of the four government-financed demonstration plants built during the war to develop and prove processes for obtaining alumina from low grade bauxite or other alumina bearing materials is at Salem, Ore. Other plants, with capacities and approximate costs are shown in the table. Ready to start, the Salem plant had been forced to delay operations several months because of the shortage of ammonium sulphate and the uncertainty of the fate of such DPC-financed units.

The process to be used at the Salem demonstration plant, that of ammonium bisulphate digestion, was developed over a period of almost five years by researchers and engineers of Chemical Construction Corp.

Early in the war it was recognized that information on processes for obtaining alumina from alumina materials other than high grade bauxite might be badly needed in case of an emergency. About this time the Columbia Metals Corp. successfully negotiated with the government for DPC financing of the Salem plant. In addition to using the Chemico process, the pilot plant has been designed and constructed by Chemical Construction Corp. After a period of initial operations by this firm, it is planned to turn the unit over to Columbia Metals Corp. for continued operation. As of this writing, details of future financial sponsorship have not been completely ironed out.

To clarify the purpose and status of the Salem alumina plant, two points should be stressed: (1) This unit, as well as the other three similar ones listed in the table, were never intended to serve primarily as commercial units nor to have the quantity output or production economics of large-scale commercial plants; (2) the unit was intended as a large pilot or demonstration plant solely to prove or disprove the technology and economics of the raw material, process and equipment and to accumulate data for use in designing and operating any similar commercial plants which some future necessity might warrant.

Some controversy, however, exists over the desirability of continuing the project after the war. Proponents center their arguments largely around four points: A need for the data for future security reasons; to prevent the project from becoming a total liability; insurance against depletion of high grade bauxite supplies; to develop a regional raw material necessary for the complete integration of the aluminum industry of the West.

DPC Plants for Testing Alumina-From-Clay Processes

	Kalunite, Inc.	Columbia Metals Corp.	Monolith Portland Midwest Corp.	Ancor Corp.
Plant location	Salt Lake City, Utah	Salem, Ore.	Laramie, Wyo.	Harleyville, S. C.
Authorized cost	$5,254,000	$4,945,000	$4,629,000	$3,163,000
Design capacity, tons alumina per day	100	50	50	50
Basic raw material	alunite	clay	anorthosite shale	clay, limestone
Process used	acid leaching	bisulphate digestion	lime-soda sinter	lime-sinter
Chief marketable by-product	pot. sulphate	none	cement material	cement mate
Beginning of operations	July, 1944	Nov., 1945		April, 1945
Status Nov. 15, 1945	closed down	operating	soon ready	operating

Expected capacity of the Salem is 50 tons of alumina per day. material would be high-quality clay from 30 to 35 percent aluminum content from a number of localities in Pacific Northwest. Initial runs will ably be from a 15,000-ton stockpile tained from the Castle Rock deposit Cowlitz county, Wash.

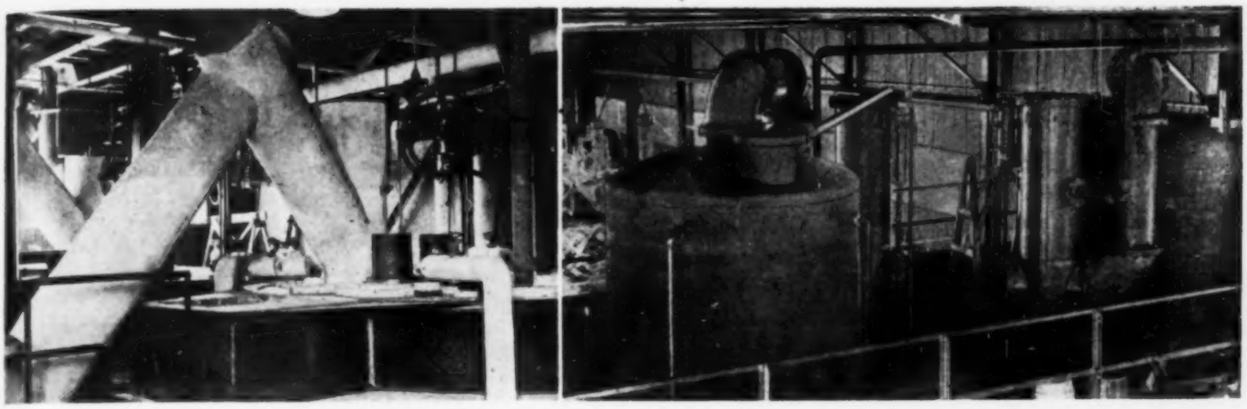
BASIC EXTRACTION PROCES

Operations of the Chemico alu from-clay process at Salem consist five basic steps: (1) Roasting of raw (2) digestion of roasted clay with monium bisulphate to form ammo aluminum sulphate; (3) vacuum crys zation and purification of the ammo alum; (4) precipitation of aluminum drate from the alum solution; (5) cal tion of the hydrate to alumina.

In addition, at least four supple tary steps are important in determi the materials economics of the pro (1) Electrothermal decomposition of monium sulphate to bisulphate, liberation of ammonia; (2) recovery this ammonia for use in forming the sulphate and for precipitation of a num hydrate; (3) recovery and crysta tion of ammonium sulphate for recycli bisulphate furnaces; (4) oxidation of rous sulphate to ferric hydrate for rem of iron from the system.

Lump clay, crushed to 0.25 in. in a hammer mill, is conditioned at 1,500 deg. F. in a rotary, oil-fired roasting kiln. Roasted and milled cl fed into the digesters simultaneously molten ammonium bisulphate from ele furnaces. In the digestion system, con ing of agitated tanks lined with resistant brick, most of the avail alumina in the clay is dissolved as monium aluminum sulphate. In addi the digestion liquor contains soluble and other metal impurities and ammo sulphate as well as suspended silica other insoluble matter.

Countercurrent rake-type sand wa remove the alum liquor from the solid purities. Wash water is fed into one of the system and ammonium alum



Left—Electric furnace (converts ammonium sulphate into fused bisulphate used in digesting the clay) showing graphite electrodes and ammonia escape ducts. Right—Vessels where ammonium alum is crystalized and purified

flows from the opposite end. Mud from the washers is pumped to a sludge pond.

The alumina dissolved from clay is separated from the various impurities also dissolved by the crystallization of ammonium aluminum sulphate. Before crystallization it is necessary to reduce iron, the major impurity, to the ferrous state as ferric iron forms an alum isomorphous with ammonium alum, whereas ferrous iron does not. The pregnant liquor from the sand washers is treated with ammonium bisulfite in an autoclave reducing ferric to ferrous sulphate and oxidizing the bisulphite to bisulphate. The solution is then sent to two vacuum type ammonium alum crystallizers, operated in series. Alum from the first crystallizer, if not of the desired purity, is redissolved and recrystallized in the second vacuum crystallizer. The crystal yield is best when the liquor is cooled in the presence of excess ammonium sulphate. In order to clarify completely the alum liquor, a rake-type classifier separates the large alum crystals from the mother liquor and fine silica.

After the second crystallization of alum, followed by a second classifying, the crystals are dissolved, filtered to remove residual insoluble matter, and fed in solution form to the aluminum hydroxide precipitators. In the precipitation, strong aqua ammonia is added simultaneously with the alum liquor at a controlled pH, temperature, and pressure into a series of steamheated agitated tanks in parallel.

This slurry of aluminum hydroxide precipitate and dissolved ammonium sulphate is passed through a vacuum cooler. Three stages of vacuum filtration on rotary filters remove the aluminum hydroxide from the mother liquor. Reslurrying of the filter cake between filtrations is used to wash the cake, which is finally fed into a rotary calcining kiln. Here the aluminum hydroxide is completely dehydrated to alumina at a temperature of about 2,200 deg. F. The calciner is provided with a cyclone and scrubber system for recovery of alumina dust.

SUPPLEMENTARY PROCESSING

Wash water sprayed on the last hydroxide filter passes through the system countercurrent to the flow of solids and is then used for redissolving the purified alum just prior to aluminum hydroxide precipitation. Filtrate from the first filters, containing dissolved ammonium sulphate, returns as a wash to the classifier.

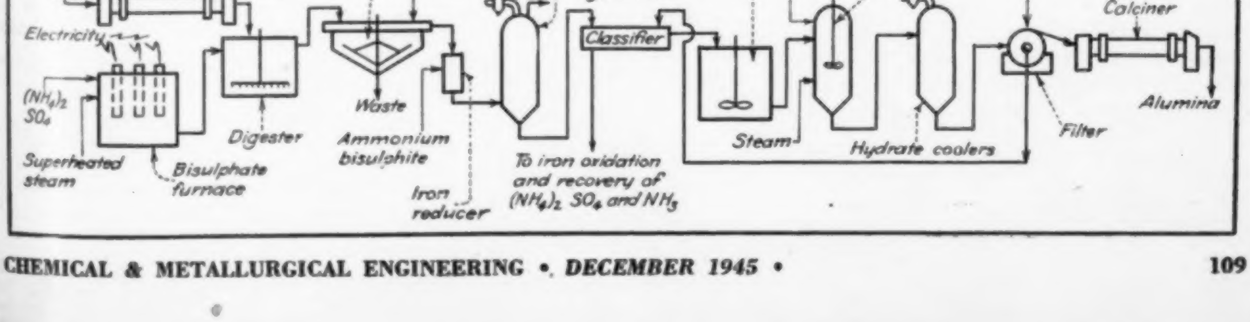
Wash liquor containing iron and other dissolved impurities, leaves the primary system with mother liquor from the first alum crystallizer. Both are treated with air and ammonia in a wood-packing oxidation tower. Here the ferrous sulphate is oxidized and ferric hydroxide precipitated. A countercurrent mud washing system separates the precipitated iron, which is discarded, from the ammonium sulphate solution which is clarified by filtration before going to a vacuum two-stage evaporator from which ammonium sulphate crystals are removed.

Wet ammonium sulphate crystals are sent through automatic continuous centrifuges while the mother liquor is returned to the system. The crystals are carried by a conveyor belt to the bisulphate furnaces where variable screws feed the material into a battery of electric furnaces of the three-phase type in which electrical resistance of the fused salt serves to heat the molten charge. Electrodes are of carbon. At about 700 deg. F. ammonium bisulphate is formed with evolution of ammonia gas. Molten bisulphate flows into the digestion tanks for reaction with the clay. Gaseous ammonia from the furnaces is cooled and recovered as 12-15 percent aqua which is rectified to 60 percent aqua ammonia for use in aluminum hydroxide precipitation.

To prevent impurities such as potassium sulphate from building up in the circulating mother liquors, it is necessary to purge the system periodically. Equipment for liming the purge and distilling off ammonia gas can be inserted, in which case the ammonia is then absorbed into the regular recovery equipment. Relative amounts of make-up ammonia, sulphuric acid, or ammonium sulphate depend upon losses from the system and composition of the different clays used as raw material.

Appreciation is due Mr. W. R. Seyfried, project engineer for Chemical Construction Corp. at Salem, and Mr. J. D. Pennell, research chemist, for their courtesies and for information contained in this article as well as to Mr. James O. Gallagher, president of Columbia Metals Corp., Seattle, for his encouragement.

Simplified flowsheet showing basic steps in the Chemico process for obtaining alumina from clay at Salem



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MOLD BRAN

Aids Production of Grain Alcohol

Manufacturers of ethyl alcohol have long striven to decrease production costs, either through better mashing processes or by use of substitute raw materials. Wartime requirements for alcohol proved the stimulus leading to the development of practical methods for production and use of "mold bran," a substitute for barley malt. Similar to many wartime developments, only postwar economics can determine the future status of this recently developed product.—*Editors*

One of the projects carried on during the war to improve grain alcohol production was the development of commercial methods to manufacture "mold bran" (a culture of *Aspergillus* oryzae on wheat bran) which could be used in place of barley malt for saccharification of grain starch to fermentable sugars. Pilot plant studies of production, and full scale experiments on the use of mold bran at the Defense Plant Corp.'s alcohol plant at Omaha, Neb., resulted in the belief that mold bran could be produced and sold for a price comparable to barley malt and that its use would bring certain economies and advantages to grain alcohol production. On the basis of these studies, especially as reported by Van Lanen and Blom,* the WPB, early in 1945 approved the priorities required for the conversion of a government hemp mill at Eagle Grove, Iowa, for production of this material by the Mold Bran Co., Inc. Commercial tonnages under the brand name of "Eaglezyme", have been produced and shipped since September of this year.

Aspergillus oryzae is a mold familiar to biologists from its old use in saccharifying rice starches to make the familiar rice beers of the Orient. Its useful diastatic values have been set forth in the literature, and application to grain alcohol production has been often considered. Actual development of practical production methods appears to have awaited the combination of circumstances brought on by wartime alcohol requirements.

Claims for its usefulness are based on tests at the Omaha plant in which 4 lb. of mold bran per 100 lb. of grain in the mash accomplished the same saccharification as the 10 lb. of barley malt customarily used. Yields of alcohol appeared to be higher. Saccharification and fermentation in the 150,000 gal. fermenters in the alcohol plant was accomplished in about 36 hr. with mold bran as against 48 hr. with barley malt.

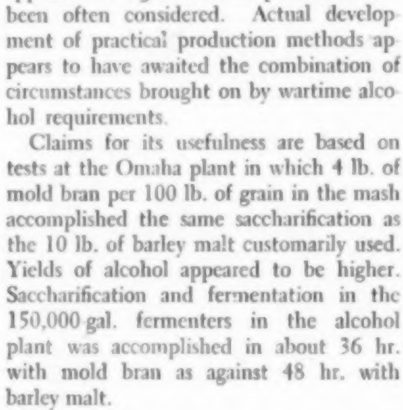
PRODUCTION OF MOLD BRAN

The method for growing *Aspergillus oryzae* on wheat bran to produce mold bran on a large scale is shown on the flow diagram. Wheat bran is mixed with dilute hydrochloric acid and the mixture is heated for 30 min. at 212 deg. F. by direct steam injection while being continuously agitated. The mixture is then cooled to about 90 deg. F. by means of an air stream and spores of the *Aspergillus* oryzae are mixed with the bran, at this stage the bran is quite free from contaminants and contains approximately 50 percent water and has a pH of about 3.5 The cooked and inoculated bran is spread out on swinging trays in a special incubator room where the trays are conveniently arranged for ease in filling and emptying. Humidified air at controlled temperature is passed over and under the trays until the maximum mold growth has occurred, which takes about 36 hr. The product is then dropped from the trays and is air dried to a moisture content of about 12 percent. The dried mold bran can be stored for long periods without loss of diastatic activity, whereas the moist material (greater than 15 percent moisture content) spoils rapidly.

Generally speaking, the process is relatively simple and requires no complicated or expensive equipment. Except for the solution system and the cookers, the corrosion problem seems negligible. Mold bran produced in the pilot plant unit showed good amolytic activity and showed no serious contamination by undesirable organisms.

Since the first of 1945, mold bran has been tested in the alcohol plant at Omaha in three different types of usage: (1) To replace extra malt in yeast culture mashes, (2) to replace entirely all malt in saccharifying fermenter mashes, (3) and to replace part of the malt in saccharifying fermenter mashes.

Flow diagram for production of mold bran (a culture of *Aspergillus oryzae* on wheat bran) at Eagle Grove, Iowa



YEAST CULTURE MASHES

It was found that the use of 2,000 lb. of mold bran per day instead of 7,200 lb. of malt in the plant yeast culture mashes resulted in better and more vigorous cultures, and in a considerable saving of time. In preparing the yeast culture mashes these are first soured by inoculating with lactic acid organisms. With the conventional malt mashes the average time

* Van Lanen, J. M., and Blom, R. H., Report on Production and Utilization of Mold Bran, Northern Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry, U.S.D.A., Peoria 5, Ill.

Table I—Effect of Mold Bran in Yeast Culture Mashes

Period, 1945	Mash Bill Percent Milo	Corn	Malt	Mold bran*	Alcohol Yield per Std. Bu. Proof gal.	Gal. 190 proof
Jan. 1-7	82.69	7.44	9.97	0	4.67	2.46
Jan. 8-14	78.89	10.71	10.40	0	4.78	2.52
Jan. 15-17	66.57	23.55	9.88	0	4.75	2.50
Jan. 18-21	66.57	23.55	9.77	0.11	5.24	2.76
Jan. 22-28	59.04	32.23	8.63	0.10	5.41	2.85
Jan. 29-Feb. 4	53.29	38.42	8.18	0.11	5.47	2.88
Feb. 5-11	33.46	57.27	9.17	0.10	5.38	2.83
Feb. 12-18	8.25	82.68	8.94	0.13	5.20	2.74
Feb. 19-25	.....	90.93	8.90	0.17	5.04	2.65
Feb. 26-Mar. 4	.....	90.16	9.66	0.18	5.04	2.65
Mar. 5-11	0.85	90.05	9.10	....	4.87	2.56
Mar. 12-18	.....	90.34	9.44	0.22	5.08	2.67
Mar. 19-25	5.52	84.99	9.30	0.19	5.26	2.77
Mar. 26-Apr. 1	3.95	86.65	9.24	0.16	5.25	2.76
April 2-8	5.60	85.17	9.13	0.10	5.23	2.75
April 9-15	11.69	79.19	8.90	0.22	5.08	2.67
April 16-22	2.83	87.98	9.02	0.17	5.02	2.64
April 23-29	1.43	89.44	8.98	0.15	5.23	2.75
April 30-May 6	0.73	90.18	8.93	0.16	5.24	2.76
May 7-13	0.71	90.04	9.14	0.11	5.19	2.73
May 14-20	3.32	87.53	9.00	0.15	5.17	2.72
May 21-27	.....	91.17	8.67	0.16	5.01	2.63
May 28-June 3	2.14	89.05	8.72	0.09	5.18	2.73
June 4-10	5.03	86.14	8.67	0.16	5.13	2.70

* Mold bran used in plant yeast culture mashes, approximately 2,000 lb. per day instead of 7,200 lb. of malt.

Table II—Results Obtained Using Mold Bran Alone

Fermenter of Period	Saccharifying Agent, Percent	Final Acidity, ml. N/10 per 10 ml. beer	Alcohol Yield per Std. Bu. Proof gal.	Gal. 190 proof
362-F-9 (3/5)	3.9 mold bran	4.4	5.16	2.72
418-F-17 (3/14)	3.9 mold bran	3.4	5.00	2.63
475-F-4 (3/23)	4.0 mold bran	4.3	5.19	2.73
540-F-9 (4/1)	4.1 mold bran	4.0	5.57	2.93
605-F-12 (4/11)	4.0 mold bran	4.9	4.96	2.61
671-F-2 (4/21)	4.8 mold bran	5.1	5.58	2.94
March	9.3 malt	4.8	5.10	2.68
April	9.0 malt	5.0	5.12	2.70

Table III—Comparison of Results from Separate Fermenters Using Mold Bran and Malt as Saccharifying Agents for the Alcoholic Fermentation of Corn

Converting Agent	Malt	Mold Bran	Malt
Fermenter No.	474-F-6	475-F-4	476-F-8
Grain bill, dry basis			
Total, lb.	105,022	152,906	106,249
Corn, percent	88.9	95.2	88.5
Mold bran, percent	0.1*	4.4**	0.1*
Malt, percent	11.0	0.4*	11.4
Balling			
Initial	15.3	15.6	14.8
Final	−0.7	−0.5	−0.3
pH			
Initial	5.62	5.17	5.13
Final	3.63	4.10	3.66
Titratable acidity			
Initial	2.1	2.5	1.9
Final	6.6	4.2	7.7
Yield of alcohol			
Volume percent	8.05	8.10	7.75
Proof gallons 1,100 lb. dry grain	10.85	10.62	10.23

* Introduced with yeast inoculum, diastatically inactive.
** 4.0% mold bran on the "as used" basis.

Table IV—Comparison of Yields when Malt is Partially Replaced with Mold Bran

Fermenter or Period	Saccharifying Agent, Percent	Final Acidity, ml. N/10 per 10 ml. beer	Alcohol Yield per Std. Bu. Proof gal.	Gal. 190 proof
707-F-2 (4/26)	4.0 malt + 1.6 mold bran	2.9	5.43	2.86
716-F-1 (4/28)	6.2 malt + 0.9 mold bran	3.5	5.36	2.82
762-F-6 (5/4)	3.9 malt + 1.7 mold bran	3.7	5.02	2.64
770-F-1 (5/5)	6.2 malt + 1.0 mold bran	4.7	5.18	2.73
842-F-1 (5/17)	5.1 malt + 2.2 mold bran	4.5	5.55	2.92
902-F-11 (5/25)	4.1 malt + 1.6 mold bran	5.0	5.12	2.70
903-F-15 (5/25)	4.3 malt + 1.6 mold bran	4.9	5.18	2.73
April	9.0 malt	5.0	5.12	2.70
May	8.9 malt	4.9	5.18	2.73

required for this souring operation was 14 hr. When mold bran is used to replace the extra malt this preliminary souring requires only 6 to 8 hr. After sterilizing the soured mashes and inoculating with yeast it was found that yeast growth is more rapid in the mashes containing mold bran instead of malt, and the resulting yeast cultures contain a larger number of yeast cells of greater activity. Furthermore, some improvements in plant alcohol yields resulted when the fermenters were inoculated with the yeast culture grown on mash containing the mold bran. Yield data for the Omaha plant by weeks in 1945 are given in Table I. For purposes of comparison the data are all calculated to the standard 56-lb. bushel of 12 percent moisture content.

Alcohol yields in any alcohol plant are somewhat variable, due to differences in kinds of grain, grain quality and variations in operation. This variability is evident in the yield data of Table I. However, the data indicate improved yields of alcohol in the plant when mold bran was used in the yeast culture mashes instead of extra malt. During the first 17 days of the year when only malt was used in the yeast culture mashes the average alcohol yield was 4.75 proof gal. per bu. Average yields immediately improved, as shown in Table I, when mold bran was used in the yeast culture mashes.

During the months of March and April six full plant fermenters were set in which the sole saccharifying agent employed was mold bran. To be on the safe side the percentage of mold bran used in the plant fermenters was kept at about 4 percent of the charge.

MOLD BRAN ALONE

However, laboratory tests have shown that in general, less than 4 percent is adequate. With barley malt, however, 8 to 10 percent must be used for satisfactory saccharification. Data for the six mold bran fermenters are given in Table II. In this table are also given data representing the averages for all malt fermenters for the months of March and April.

It is difficult to draw exact conclusions from the results of single fermenters because of variability of grain, operating conditions, etc. The yields obtained from the mold bran fermenters were therefore compared with the malt fermenters set just before and just after each mold bran fermenter. Of the six fermenters saccharified with mold bran one (605-F-12) gave a slightly lower yield than the companion malt fermenters, two (418-F-17 and 475-F-4) gave almost identical yields as the companion malt fermenters, and the other three (362-F-9, 540-F-9 and 671-F-2) gave slightly higher yields than the companion malt fermenters. Table III shows a comparison of results from separate fermenters using malt and mold bran as reported by Van Lanen and Blom.

Previous laboratory research has shown that malt and mold bran amylases have a supplemental or synergistic action. When the two are used together the amounts of each required cannot be predicted on the basis of a linear relation. During April and May seven fermenters were run in the Omaha plant, the mashes of which were saccharified by the use of mixtures of malt and mold bran. Data for these fermenters are given in Table IV along with the averages for all malt fermenters for April and May.

PARTIAL REPLACEMENT OF MALT

Of the seven fermenters, three (762-F-6, 716-F-1, and 770-F-1) gave slightly lower yields than the companion malt fermenters set just before and just after the fermenters saccharified with the malt and mold bran combinations, while the other four gave slightly higher yields than the companion malt fermenters.

The average alcohol yield from all seven of the fermenters saccharified with malt and mold bran combinations was 5.26 proof gal. per standard bu. The average yield of all malt fermenters for April and May was 5.15 proof gal. per bu. These figures indicate that the average yield in the plant from the fermenters saccharified with malt and mold bran combinations has been 2.1 percent better than the average yield during the same period for the malt fermenters.

A. R. MAAS *President, A. R. Maas Chemical Co., South Gate, Calif.*

PHOSPHATE PHILOSOPHY

Philosophizing doesn't produce phosphates, but a little figuring on the economics does help to produce profits. Herein one experienced manufacturer sets down his observations on the two rival processes for making phosphoric acid.—*Editors*

To philosophize on the manufacture of phosphoric acid and sodium phosphates chiefly from an economic rather than from a theoretical angle is more fitting to the personality of phosphorus. Right now the subject is timely, for elemental phosphorus in the form of smoke and incendiaries has been an essential hell-raiser in this war; phosphates have long been a prime necessity for food raising.

In this country, animals obligingly left their bones in great beds to form our present phosphate deposits of Tennessee and Florida, but out in Idaho and Montana the origin of phosphate rock was so peculiar as to seem impossible. During the Permian period, some 200 million years ago more or less, when our northwest was a great inland sea, certain types of microscopic rotifers (which look like diatoms) had minute shells of calcium phosphate. Upon death, our little rotifers would "shuffle the mortal coil" of phosphate—by the quadrillions. Actually, one must have the imagination of an astronomer to appreciate just how many individual microscopic shells were necessary to build up the 8 billion tons of phosphate reserves in the West.

THE RIVALS

When man found that he just must have phosphates from these great deposits, he tackled the extraction problem in two ways that made it part of the great economic battle of chemical technology all over the world: "Which is economically sounder, to use cheap, impure raw materials and produce products just good enough to get by or to choose more expensive raw materials and make products almost chemically pure?" Of course, there is no easy and general answer, but in more and more cases the latter choice is winning this race for the survival of the more economic.

As a chemical manufacturer, I have had personal encounters with this great conflict. One experience has been with the two rival phosphate processes. In this case, neither has scored an outright national victory—but the new, pure scheme is winning battles, while the old is not quite holding its own. This tussle deserves attention simply for the economics involved.

The old or wet process of making phosphoric acid and phosphate starts with mining, crushing, perhaps concentrating, drying and lightly calcining the phosphate rock (which is, in a vague way, a basic fluophosphate of lime contaminated with just about everything). Next comes acidification. Here the rock is mixed with dilute sulphuric acid often made by the chamber process in the same plant. It is then settled and washed by the countercurrent principle in huge thickeners. The strength must be kept down to about 28 percent H_3PO_4 in order to get decent settling. Corrosion is bad. The dilute effluent is boiled down in special acid-proof evaporators to 75 percent H_3PO_4. The liquor must then be settled for days or even weeks to get rid of a part of the lime salts.

The table (p. 114) shows a typical analysis of wet phosphoric acid made this way. Now this acid has the distinction of being one of the most impure chemicals on the market. To be sure, some commercially satisfactory phosphates can be made from it with difficulty, but the cost of purification required for the food and drug grades is just too much.

ROTIFER HEMOGLOBIN

Those little rotifers mentioned before required an oxidizing catalyst in their life fluids, but instead of using hemoglobin with iron as we do, they used vanadium. Our chemical staff was intrigued by the 0.25 percent vanadium they left behind in western phosphate rock, chiefly because it becomes trisodium vanadate, which is isomorphous with trisodium phosphate, and thereby pretty much of a nuisance in our manufacturing operations. That sort of accidental success which so often rewards persistence led our staff to the discovery of several new compounds of vanadium.

One of these was phosphovanadic acid (PVA) which is fairly soluble in water but is almost insoluble in 75 percent phosphoric acid. Don't try to look this compound up in the books—it isn't there yet. But its formula is $V_2O_5.P_2O_5.4H_2O$ and its yellow crystals are beautiful.

Based on the properties of PVA, here is the vanadium recovery process finally worked out and now used industrially. The original phosphoric acid contains V_2O_5 which is quite soluble and of strong green color. Just enough sodium chlorate is added to oxidize this to insoluble phosphovanadic acid, which can be reworked to high-purity V_2O_5, now in great demand for making vanadium steels. The Anaconda Copper Mining Co., which makes a large tonnage of phosphoric acid in this way, has adopted our process for recovering vanadium and has recently been turning out close to 10 percent of the nation's total of this metal. Every pound that could be produced went into the war effort.

Now to come back to our thesis of the eternal conflict between the truly pure and the almost-good-enough. The rival electric furnace phosphate process is utterly different. Tennessee phosphate rock is preferred because ample electric power and coke are close at hand. The rock is furnaced with coke, silica and some iron ore occurring naturally in the phosphate. This is done in the absence of air in electric furnaces. The furnace gases, consisting of carbon monoxide and phosphorus, are cooled. Yellow phosphorus, which melts at 44.1 deg. C., is recovered. The iron ore in the charge is reduced to ferrophos, Fe_2P, for which happily there is a demand for certain steels. This sublimation process yields a phosphorus of such marvelous purity that it exceeds 99.99 percent. Sometimes there is a trace of arsenic, but that is easily removed from phosphoric acid by precipitation with H_2S.

ETERNAL ECONOMICS

Now look at the basic economics of the process. Phosphate rock contains only about 13 percent phosphorus and cannot bear the freight cost of a long haul. Electric power is obtainable from TVA at very low rates but cannot be exported far. Satisfactory coke is obtainable in Tennessee. So the thing to do is to make phosphorus on the spot, ship it thousands of miles to a factory established near the consumer and make the phosphates there. Thus Victor Chemical Works produces phosphorus near Nashville, Tenn., and ships it to Chicago; Monsanto Chemical Co. also takes the element from Tennessee and ships it to a new plant near Detroit.

we obtain our phosphorus from one of these Tennessee producers and ship it to Los Angeles. Thus a pound of elemental phosphorus goes a long way to make 4.2 lb. of 75 percent phosphoric acid or 12.2 lb. of trisodium phosphate crystals or 3.64 lb. of anhpdrous sodium pyrophosphate.

But clearly it is necessary to have a much cheaper way of shipping phosphorus than the old-style sealed drums. That problem has been beautifully worked out. Liquid phosphorus recovered from the electric furnaces is run into large storage tanks full of warm water, the phosphorus being safely sealed from air by the water. For shipment it is pumped into 50-ton tank cars full of warm water, displacing its own volume of water and never reaching the air. The tank car with its floating seal of water is shipped thousands of miles; the receiver simply runs hot water through a pipe system to make sure the phosphorus is melted. Then warm water is pumped into the car and the phosphorus is forced out and into a storage full of warm water. Then last of all, when the phosphorus is used, warm water forces it from storage to the burner.

Phosphorus burners are not greatly different from fuel oil furnaces. The phosphorus burns with a big flame to a smoke of P_2O_5 and the fumes are recovered in absorbing towers fed with water. The product is water-white, pure phosphoric acid of any strength desired, usually 75 percent H_3PO_4 which does not freeze or become too sirupy in cold weather. U.S.P. grade must be 85 percent. Higher strengths give real danger of freezing, for 100 percent acid freezes at 42.35 deg. C.

This idea of absorbing P_2O_5 fumes in water is not simple and obvious. It was first worked out in 1928 by the Russian (now American) chemist Vladimir Ipatieff.

Materials of construction of a modern phosphoric acid plant are stainless steel, carbon blocks and synthetic rubber. Resistance to corrosion of a properly designed plant is excellent. The phosphoric acid is shipped in rubber-lined tank cars.

OSTRACIZED ACID

Uses of pure phosphoric acid are so varied that they seem incredible. The crude acid, on the other hand, does not always get admitted into consuming plants. Here are a few industrial uses that cannot be properly met by the old style wet-process acid: (1) Purifying solutions in sugar refineries; (2) cleaning electrodes in magnesium plants; (3) feeding yeast to grow B vitamins; (4) making cheese; (5) flavoring certain popular soft drinks; (6) rustproofing sheet steel and machined parts.

This last application is especially interesting and makes use of two closely related processes. Bonderizing consists of a very quick treatment of sheel steel with phosphoric acid plus catalysts. Time, very important, has in the last few years been cut from hours to seconds. The purpose is to give a rough, tough, non-rusting base for lacquers. It is used on all automobile bodies before painting and lately is replacing tin on cans for certain types of food, being always followed with a lacquer. Strange to say, neither tinplating nor lacquering nor bonderizing alone will protect steel. Parkerizing, also using phosphoric acid, is not so fast and uses different catalysts. It is applied to machined surfaces to get a hard, tough, rustproof coating without change of dimensions. It must be finished with some form of oiling. Items like parts of rifles or motors or small tools are treated in this manner.

The pure grade of phosphoric acid is the only one good enough to make such products as baking powder and self-rising flour for our biscuits, doughnuts, cakes, pies and similar fattening foods. We are, of course, our own largest consumers of phosphoric acid, having originally not taken the outside market for acid seriously.

PYRO MAKES THE GRADE

We make sodium pyrophosphate by mixing acid, soda ash and caustic in the right proportions and furnacing to $Na_4P_2O_7$. Two great types of uses have developed for this chemical. A few hundredths of a percent added to the drilling mud used in sinking oil wells controls the viscocity at any desired point. So little pyro added to so much mud amounts to quite a few carloads. Recently it was discovered that 10-25 percent added to soap powders increases detergent effect and lathering greatly; since it is cheaper than soap, its use is no extravagance. All the big soap companies have been using as much as the government will let them have.

Pyrophosphate has the extraordinary property of dissolving magnesium precipitates if it is present in excess. It dissolves calcium precipitates also, though not so freely, but it usually peptizes what it does not dissolve—which is just about as good in laundering.

Pyrophosphate can be prepared as the crystal $Na_4P_2O_7 \cdot 10H_2O$ and its quick solubility and non-caking habits recommend it for home use. We don't know yet how important it may become. There is an acid pyrophosphate too, $Na_2H_2P_2O_7$. Its chief uses are for baking powders and for drilling oil wells.

We can also mix the phosphoric acid and soda ash in the same proportions and heat at a carefully controlled temperature. Our product is anhydrous disodium phosphate, which has the same uses as the standard crystals but is 252 percent as strong. Saving in packaging and freight is so great that I expect to see it largely replace the crystal, which has the further drawback that it cannot stand really hot weather.

Some place disodium phosphate on the sick list of chemicals because its tonnage use has declined in recent years. But a five-year experiment down in Texas has just proved that cattle fed this chemical, either in drinking water or in cottonseed meal, weighed an average of 297 lb. more at market time. The annual amount of phosphorus per animal was 24-53 lb., so that at 7.5 cents per lb. for anhydrous DSP this extra beef was made for only 3-6 cents per lb.

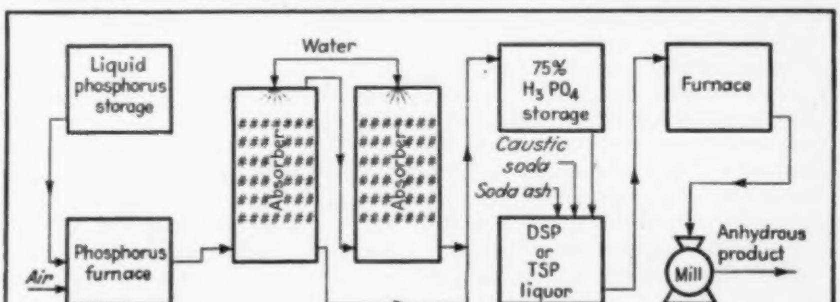
Suppose we take the mix prepared for making sodium pyrophosphate and add one equivalent of caustic soda and go ahead and furnace in the same way. Our product is anhydrous trisodium phosphate. This has the same advantages in packaging and freight, since it is 232 percent as strong as the crystal; naturally we look for a large demand among industrial users. Probably it won't appeal to domestic trade because it is slow to dissolve and the American housewife is too impatient to give it the needed two minutes.

WHAT, NO FILTERS?

It is an extraordinary fact that all our phosphate products mentioned so far except some very small newcomers are made without filters, evaporators, crystallizers, centrifuges or dryers. In all my past life as a chemical manufacturer, these have been the essence of our business. But very slowly we are coming to see that they are sometimes expensive. Installing just one new phosphorus-burning furnace, a simple thing, has permitted all these changes.

Next is a product that can still be made

Flowsheet for production of sodium pyrophosphate or trisodium phosphate; either may be made from the 75-percent acid by varying amount of caustic



economically from wet-process phosphoric acid and still requires those five old-order pieces of equipment. That is crystal trisodium phosphate dodecahydrate, affectionately known as TSP. All chemical books without exception give its formula as $Na_3PO_4.12H_2O$. It isn't! It comes nearer to $Na_3PO_4.\frac{1}{4}NaOH.11H_2O$ but no two crops are exactly the same, varying as they do with the liquor from which they are made. Even the crystal form is a bit unique, for it is hemihedral hexigonal—that means that one of every pair of faces is missing. It will take into its molecule up to about one-quarter equivalent of almost every sodium salt of a monobasic acid, such as $NaOH$, $NaNO_3$, $NaCl$, $NaBO_2$, $NaOCl$ and NaF. It won't pick up salts of dibasic acids, such as Na_2SO_4, Na_2SiO_3 or Na_2CO_3. Yet it will take into its crystal structure the isomorphous Na_3VO_4 and Na_3AsO_4 and probably the antimony salt too. Now all of this is not in the books, never before published and subject to many complications.

One of these forms, the nitrate-phosphate, was discovered and patented by us and is now being marketed as an improvement on TSP because it shows greater detergent value, less caustic irritation and better resistance to caking. Its crystal form, like most of the double salts mentioned, is the same as TSP and its composition is variable. It is more like a solid crystallized solution than any orthodox chemical compound.

Our laboratory once ran a series of successive crystal crops from a TSP liquor that was adjusted exactly to Na_3PO_4 just to illustrate the point that the crystals are not of the same composition as the liquor, but tend to rob it of its soda. And, incredible as it may sound, the seventh crop is not all TSP but is half disodium phosphate, easily recognized by its monoclinic crystal form. This disodium phosphate does not agree with its usual textbook formula, for it analyzes $Na_{2.[illegible]}H_{0.[illegible]}PO_4.12H_2O$ while the TSP crystals mixed with it in the same crop correspond to $Na_3PO_4.12H_2O$ exactly.

Trisodium phosphate may be old to chemists but it is still a novelty to most consumers, whose normal reaction is "Why didn't someone show me this before?" We were the first to produce it in California in 1929. Our production is now 700 percent what it was ten years ago. We expect to keep on expanding, for most possible customers have never yet seen it.

Principal uses of trisodium phosphate are as water softener and heavy cleaner. Most washing compounds, dishwashers, boiler compounds, soap powders and such contain more or less of it and usually the more the better.

Typical Analyses of 75 Percent Phosphoric Acid

	Percentage Composition Wet Process	Electrothermal Process
P_2O_5	53.50	53.50
CaO	0.25	0.00
MgO	0.09	0.00
Fe_2O_3	1.00	0.00
Al_2O_3	0.99	0.00
SiO_2	0.14	0.00
F	0.77	0.00
As_2O_3	0.02	0.00
Na_2O	0.03	0.00
K_2O	0.02	0.00
SO_3	2.55	0.00
Cr	0.06	0.00
V	0.24*	0.00
Cu	0.006	0.00
Mn	0.07	0.00
Pb	0.0005	0.00
TiO_2	0.58	0.00
Zn	0.05	0.00
Ni	0.002	0.00
Ba	<0.0005	0.00
Sr	<0.0005	0.00
B	<0.0005	0.00
Mo	0.01	0.00

* In acid made from Montana, Idaho and Utah phosphate rock.

CHEMICAL ENGINEERS

(*Continued from page 97*)

men wrestling with theoretical problems. When either one fails to progress toward the satisfactory solution of his problem and feels that he could handle the other's job better, both the quality of work and the time required to complete it become uneconomical. Managements and the profession have a joint stake in resolving this long-standing problem of professional-subprofessional relationships. Recent experience of personnel departments in matching skills with job requirements would contribute greatly to a better placement of engineers, once all groups involved saw the need for concerted action.

3. Supervisors of engineers, especially if they are engineers themselves, sorely need a drilling in the principles of good supervision. This is particularly true for the men assuming their first supervisory assignment. The engineer, confident in his mastery of inarticulate materials, fails to recognize that human material does not obey the same laws. He fails to realize the essential change in his function from engineering to supervision and so blunders into mishandling of people. Managements have succeeded so remarkably in improving supervisory relations with the production men that they can well afford to impart some of that know-how to their engineering staffs.

4. Even though the engineers form a small minority of the total personnel, application of the most progressive personnel techniques is justified. The long-run productivity of an engineer is largely determined in his first year or so of employment. If he happens to be a man with many aptitudes and interests that his first work assignments do not utilize, he will become restless and discouraged. Frequently, these aptitudes are sorely needed in some inter-functional work of great importance to the organization. Frequently use of these interests will justify transfering a man with a sound engineering understanding into such work as cost accounting, sales service, or planning. Managements should inventory the aptitudes and interests of their engineers and then make actual use of that information in logical reassignments.

5. At the same time, the personality of each man should be analyzed, especially to determine the degree of association with other people necessary to bring out the best work in a man. Teamworkers should then be put into group projects, strong extroverts without pronounced leadership traits placed in contact work, and the self-sufficient introvert given independent assignments.

6. Since the engineer is furnishing services, services that lean heavily upon mental sharpness, he should be urged to revert periodically to the study of his basic principles. Right now the pent-up need of many men to catch up with recent developments warrants the organization of refresher courses. These courses may last one to four weeks and should be given on the campus by the best teachers. Industry can well afford to maintain compensation and to subsidize part of the other expenses in order to have its engineers resharpen their minds. An engineer should be free to take any combination of courses in the engineering, natural science, biological sciences or social science fields that has any bearing upon his own or his organization's work.

An effective salvage program requires a thoroughgoing cooperation of managements, personnel departments, and engineers. The engineers must initiate and carry the burden along lines of self-development. The personnel departments must adopt new attitudes toward engineers and apply techniques found effective with other groups.

Managements must study the problem long enough, and hard enough, to understand the importance of the engineering function, the nature of the engineer as a unique human being, and the necessity for directing personnel thinking about engineers along broader lines. By scrutinizing the effects of their past personnel policies and by exploring the values to be gained from changed viewpoints, enlightened managements can retain many of the more talented men in the intermediate and lower levels who are now inclined to search out other employment. By salvaging what men they have and putting them to better use, these managements have the power to soften the fullest shocks of the impending shortages.

These Methods Avoid Trouble in Converting Viscosity Units

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Rational calculations in the field of fluid flow must include the viscosity of the fluid as one factor. It is necessary that the viscosity of the fluid be expressed in the proper units if correct numerical results are to be obtained. But there has been no standardization in this field, so that authors of textbooks and journal articles use various viscosity units, and this may lead to error when a formula intended for one viscosity unit is to be applied to data expressed in terms of some other unit. The situation is made more confusing because the very concept of viscosity seems difficult for some to grasp, so that spontaneous selection of the proper unit is not likely.

Facing this difficulty in discussing fluid flow with Fellows at the Institute of Gas Technology* who had diverse educational backgrounds, the author found it helpful to use a simplified concept of viscosity to show how the proper units could be chosen for any particular problem; a conversion table was also given which could be used if data were in terms of some unit different from that in the formula.

It was pointed out that when a fluid is flowing past a smooth solid there is a force exerted by the fluid on the solid tending to cause the solid to move along with the fluid; there is an equal force exerted by the solid on the fluid tending to stop the flow. The force is proportional (1) to the area of solid-fluid interface, and (2) to the value (at the interface) of the rate of change of fluid velocity with distance from the solid. For those to whom the latter half of this statement was difficult, it was necessary to use the approximation that the force is proportional to the quotient obtained by dividing the velocity of the fluid at a very small distance from the solid, by the distance. Since the velocity gradient changes very slowly near a smooth solid, whether the flow be turbulent or viscous at a greater distance, the approximation is not bad. Then in symbols

$$F = \mu A(du/dy) \qquad (1)$$

where F is the force, A is the area, u is the velocity, y is the distance from the solid, and μ is the proportionality constant, which is a property of the fluid.

Where the c.g.s. system of units is used, force is expressed in dynes, area in square centimeters, velocity in centimeters per second, and distance in centimeters, so that the unit of viscosity is the dyne second per square centimeter. (This unit has been named the poise, in honor of Poiseuille, who discovered the law of viscous flow through cylindrical tubes.) To show this, Equation (1) is solved for μ:

$$\mu = F/[A(du/dy)] \qquad (2)$$

Substituting units for symbols, then:

$$\begin{aligned}\text{Unit of } \mu &= \text{dyne}/[\text{sq. cm. (cm. per sec./cm.)}] \\ &= \text{dyne}/[\text{sq. cm. (reciprocal second)}] \\ &= \text{dyne second/sq. cm.}\end{aligned}$$

Since the dyne is 1 gram centimeter per second squared, the c.g.s. unit of viscosity is frequently transformed from the dyne second per square centimeter to the gram per centimeter second. This transformation is in accord with the accepted practice of expressing derived units systematically in terms of the three fundamental units which in the c.g.s. system are, of course, the centimeter, gram and second.

ENGINEERING UNITS

In engineering practice it is usual to use the pound as the unit of force, the square foot as the unit of area, the foot per second as the unit of velocity, and the foot as the unit of distance. It follows that the unit of viscosity is the pound (force) second per square foot.

Sometimes the engineering unit of viscosity is given as the slug per foot second, by analogy with the gram per centimeter second. While this is correct, it is awkward and unnecessary since the pound (force) second per square foot is expressed in terms of three fundamental units. The use of the slug per foot second should be discouraged but, of course, it should be recognized when seen.

There is a less frequently used system in which the poundal is the unit of force. In this system the unit of viscosity is the poundal second per square foot. The fundamental units in this system are the pound, foot and second so that it is proper to transform the poundal second per square foot to the pound (mass) per foot second. This unit of viscosity is frequently used.

Some chemical engineers use a "system" of units having four fundamental units—the pound (mass), the pound (force), the foot, and the second. In this "system," the unit of viscosity may be either the pound (force) second per square foot or the pound (mass) per foot second. It is necessary to be on guard in reading the older chemical engineering literature because frequently pound appears without the qualifying (force) or (mass) and it is necessary to study the use to decide which one is meant.

Having decided which unit of viscosity is to be used in a calculation, it is necessary to make sure that the viscosity of the fluid being considered is given in terms of that unit. If the viscosity is given in terms of another unit, conversion is needed.

In making conversions the accompanying table will be found useful.

As an example of such conversion consider the isothermal viscous flow of gas through a tube of cylindrical cross section for which the formula is

$$Q_0 = \frac{\pi D^4 (P_1^2 - P_2^2)}{256\, \mu P_0 L} \qquad (3)$$

where Q_0 is the flow rate in standard cu.ft. per sec.; D is the tube diameter in ft.; P_1 is the inlet pressure in lb. per sq.ft. absolute; P_2 is the exit pressure in lb. per sq.ft. absolute; μ is the viscosity in lb. sec. per sq.ft.; P_0 is the standard pressure; and L is the tube length in ft.

To use this formula to calculate the flow of nitrogen, it is necessary to know the viscosity of nitrogen in pound seconds per square foot. From the literature it is learned that at 40 lb. per sq.in. abs. and 100 deg. F. the viscosity of nitrogen is 0.0001800 poise. But the numerical value to use in the formula is not 0.0001800. The correct numerical value is 0.0000003760, obtained as the table directs by multiplying 0.0001800 by 0.002089.

It is to be hoped that there will be standardization on a single English unit of viscosity, but until such standardization occurs it is quite likely that some contributors to engineering literature will continue to use English units for everything else, but report viscosity in poises. But whether the poise or any other unit be used, use of the conversion table will help to eliminate numerical errors.

Viscosity Unit Conversion Factors

1 poise = 1 dyne second per square centimeter
1 poise = 1 gram per centimeter second

1 pound (force) second per square foot = 1 slug per foot second
1 pound (mass) per foot second = 1 poundal second per square foot

To Convert to	Multiply the Number of Poises by	Multiply the Number of $\frac{\text{Lb (force) sec.}}{\text{sq. ft.}}$ by	Multiply the Number of $\frac{\text{Lb. (mass)}}{\text{ft. sec.}}$ by
Poises	1	478.8	14.88
Lb. (force) sec./sq. ft.	0.002089	1	0.03109
Lb. (mass)/ft. sec.	0.06721	32.174	1

* This article is an outcome of part of the author's work as consultant to the Institute of Gas Technology, Chicago, to which organization acknowledgment is made.

FROM THE VIEWPOINT OF THE EDITORS—

A GOOD START

Policies with regard to atomic fission control announced after President Truman's conference with Prime Ministers Attlee and King seem to offer at least the prospect of a workable solution to this most urgent of postwar problems. Following so shortly after some of the President's earlier and less thoughtful pronouncements, the joint proposal has come as a pleasant and hopeful surprise to the scientists and other technical men who have understood the impossibility of keeping the atomic secrets for more than a little while.

It is another question whether the peoples not now "in the know" will follow along with these sensible proposals. Presumably they will either do so, or they will take their cue from Russia. If the latter nation decides to remain suspicious of our motives and accepts the challenge of those vocal and ill-informed elements who have been demanding that the "secret be kept," then the prospects for the future are dismal indeed. Nothing short of an atomic armament race will be possible.

On the other hand, if Russia can be made to realize that the English-speaking two-thirds of the Big Three are in fact seeking only for peace in a better world, then there should be no insuperable problems. This is a job for diplomacy on the topmost levels, and one that must be undertaken quickly before further misunderstanding can develop. Meanwhile, is it too much to ask in the interests of international amity, that the carping at our ally be toned down, at least until we know what we are carping at?

SALVAGE THOSE ENGINEERS!

During the war some of us learned to get along with what we had. Rationed raw materials, inadequate equipment and production facilities, and a diminishing supply of technical manpower were the things we complained most about. Gradually now we are finding relief from all except that last and most important of our troubles. And the educators tell us that we must wait until at least 1950 before there will be a normal supply of young chemical engineers for industry. What can we do about it?

Elsewhere in this issue of *Chem. & Met.* an unusually gifted writer offers management at least one very practical answer. If we must get along with what we have in the way of engineering manpower, it behooves us to see that it is properly used. In the hurry-up of war production there have undoubtedly been many misplacements of technical personnel—many square pegs put into round holes. But the problem is not quite so simple. Often there are mental adjustments to be made and they depend as much on the man as on the management.

So all of us can read Mr. Hopkins' article with profit and ponder seriously the six points in his corrective program. Later on he promises us another philosophical article to show what industrial psychology can do to help in straightening out some of the tangled personnel problems we have inherited from five years of war.

INCREASING ABILITY TO SEE

Dr. Samuel Renshaw of the Department of Psychology of Ohio State University has done a great deal of work in training people to see more quickly and accurately. Recently he took 56 chemists, physicists and engineers from Battelle Memorial Institute and gave them a short course to determine what improvements could be made in their reading abilities. Their average rate at the start was 262 words per minute or 6 percentile points above that for average college freshmen. They were given a course of 25 sessions of 45 minutes each at the rate of two a week. Because no other time was available, these sessions were given between 5:15 and 6 p. m.—an hour when the men were naturally tired. Nevertheless, the average reading rate was raised from 262 to 313 words per minute and the comprehension increased from 52 to 85 percent. As reported by Dr. Renshaw in the *Journal of Psychology*, 1945, Vol. 20, pp. 217-32, there is evidence that a continuation of the course would actually lead to a doubling of the reading rate.

Ohio State is said to be seriously considering the introduction of this sort of training into the regular engineering curricula. If it is possible so greatly to increase the efficiency with which we use that most useful of all our instruments of precision, such a move might prove of far-reaching significance for the engineering profession.

BUREAUCRATIC ERUDITION

This does not have quite all the earmarks of truth but we copy it directly from the *Philadelphia Inquirer* of November 22: "A Government bureau received an inquiry as to whether hydrochloric acid could be used to clean a certain type of boiler tubes and answered 'Uncertainties in reactive (sic) processes make use of hydrochloric acid undesirable where alkalinity is involved.' The man making the inquiry wrote the bureau thanking the Government for its advice and saying he would use hydrochloric acid. The bureau then wired him: 'Regrettable decision involves uncertainties. Hydrochloric acid will produce submuriate invalidating reactions.' The man wrote again, saying that he was glad to know that use of hydrochloric acid would be all right. The bureau then wired: 'Hydrochloric acid will eat hell out of your tubes!'"

CHALLENGE OF CHRISTMAS, 1945

"....only as we are able to purge bitterness from our souls are we in a position to begin the reconstruction of a world that is terribly sick, not only with confusion and hunger and disease, but with hatreds more terrible than them all. This is the appalling challenge of Christmas, 1945."

Thus writes the first editor and founder of "Silicate P's and Q's" in the silver anniversary issue of that brave little publication of the Philadelphia Quartz Co. Since he chose to retire from its editorship five years ago to carry his ministrations to troubled peoples in other parts of the world, James G. Vail, vice president of PQ, has regularly contributed the annual Christmas editorial. This year's message closes with these pertinent thoughts:

"No individual and no business group can change the course of history, but it does not follow that what each of us does personally or corporately is unimportant. Countless millions of molecules polarized to the cathode make electroplating possible; the end result is the sum of individual orientations. So we resolve this year to try to act in the spirit of mutual interest, to think through to end-uses of our products which are helpful in a community sense with the whole human family as the community. When tempted to be negative we shall seek affirmation, or confronted by anger we shall try to understand the cause and find the reconciliation. That seems to us the foundation of peace and at least a part of the implications of Christmas."

EFFECTIVE COOPERATION

Between now and Jan. 1, 1946, the local sections of the national engineering and technical societies in the Buffalo-Niagara Frontier have an opportunity to accept a carefully drawn program setting up a new joint organization to be known as "The Engineers' Council." For many months a steering committee of representatives from the various local sections and societies has been at work on this charter and constitution designed to promote cooperation among engineers and allied technologists of western New York. Means are provided to act on matters of mutual concern to these professions and on engineering, technical and scientific problems in which the public interest is involved. Greater participation in civic affairs both as members of their chosen profession and as citizens as well is a stated objective. So are plans for interchange of information on programs and speakers with the view of avoiding duplications of subjects and conflicting dates of meetings.

To be sure, there is nothing very new about this activity in the Buffalo area. Something comparable has been practiced for many years in Syracuse and Providence, Cleveland and Detroit, St. Louis and Chicago. Within the month a constitution has been adopted setting up the Technical Societies Council of the Kansas City Area, with seventeen different local organizations as its sponsors. This marks a most important trend, for in our opinion the most promising opportunity for effective cooperation on the part of engineers as citizens is on the level of the local sections. When the officers and members are sufficiently farsighted to pool their strength and interest they greatly multiply that opportunity for service to their communities and to themselves.

AT TAXPAYERS' EXPENSE

Industry can incur operating losses by paying wages that are high beyond reason. The resulting loss may be largely transferred by a skillful corporation into an expense which is deducted from the tax bill of the company. Thus the taxpayer is, in effect, paying the excess wages.

General Motors Corp. charges that UAW-CIO leaders are demanding that the corporation follow that policy. The corporation says "We will not be a party to a proposal to subsidize the prices of our products at the expense of the taxpayers." They thus resist the proposal.

Certainly, it is not feasible for us to determine either the proper wage rates for motor-car builders or the exact significance of various steps in their labor controversy. But we do believe that it is proper to express an opinion regarding the use of the tax laws for evasion of sound economic and social decisions. We think any such proceeding as is being charged against UAW is a highly reprehensible one. Whether the UAW actually did what is charged or not, we are glad that such a proceeding has been spotlighted by the controversy so that it may be openly discussed by all.

No one should hesitate also to condemn the wasteful spending of corporations on projects of very nominal value merely "because the money comes out of the tax bill." There have been numerous firms that have done things that looked to us like very careless spending because they seemed to be justified only on the ground that they are business expenses that could be charged off largely against taxes,

It is high time that every American faced the fact that all the people pay the taxes. No spending that is not otherwise fully justified should be undertaken in a way that amounts to tax evasion. America as a whole can not afford that class of spending on the part of anyone, industry, labor, or individual.

WAITING FOR SANTA CLAUS

It is always nice to have someone else pay for the things we want and enjoy. Several local and state government agencies seem to be holding up their programs in an effort to get Uncle Sam to pay the bills for new waterworks, sewage disposal plants and other public works.

There are two serious disadvantages in this waiting for Santa Claus. In the first place, there is a first-class chance of disappointment. Even the nicest letter to Santa is not always answered with precisely the requested gift. But much more serious is the danger that too long a postponement will make it impractical to secure the services of the better firms and better equipment because these will be tied up by fore-handed cities and states.

Chemical engineers are interested in some phases of these construction programs. Working with the Committee for Economic Development, the local sections of many of the engineering societies have been surveying the needs of their local communities. The members can well exert their influence now for prompt preparation of plans and placing of orders. And, incidentally, in their own businesses they may well take to heart the idea that industrial waiting for Santa is probably no better than this municipal variety. That conclusion applies particularly to waste-disposal projects of industry and, for that matter, also to other varieties of industrial construction.

CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

$50 VICTORY BOND FOR A GOOD IDEA!

Until further notice the editors of *Chem. & Met.* will award a $50 Series E Bond each month to the author of the best short article received during the *preceding* month and accepted for publication in the "*Chem. & Met. Plant Notebook.*" Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department. (Right is reserved, however, to make no award in months when no article received is of award status.)

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

NOVEMBER WINNER!

A $50 Series E Victory Bond will be issued in the name of

T. P. HIGNETT
Chemical Engineer
Tennessee Valley Authority
Wilson Dam, Tenn.

For an article dealing with a home made slagging type gas producer for pilot plant use that has been judged the winner of our November contest.

This article will appear in our January issue. Watch for it!

October Contest Prize Winner

HOW CAPACITY OF A DRUM DRYER WAS DOUBLED WITH A SMALL ADDITIONAL INVESTMENT

H. F. REICHARD
Chemical Engineer
Milltown, N. J.

A DIP-FEED, steam-heated drum dryer was being used to dry an organic solid from a 30 percent water solution. The general arrangement is shown schematically in Fig. 1. The solution was fed into the pan continuously. The drum was rotated at a constant speed and was continuously supplied with 100-lb. steam. There was a hood over the dryer with a stack containing a suction fan to force circulation of air from the surrounding room over the drum surface. The organic being dried was built up on the drum during passage through the feed pan. Drying was completed during the remainder of the drum rotation and the dried product was flaked off by a doctor knife.

It was desired to increase production of the dried material, and so means of increasing the dryer capacity was studied. It was found that the product was satisfactorily dry by the time it had travelled halfway to the doctor blade. Therefore, it could be seen that the unit would dry at a much faster rate if a way could be found to build up a thicker cake on the drum. Varying the drum speed within practical limits of the drive did not affect the output since the cake thickness was found to be approximately inversely proportional to drum speed. A special ingredient in the solution which was at the saturation concentration in the feed liquor prevented the use of a preconcentrator.

It was decided to conduct tests on a system of increasing cake thickness by spraying feed solution on to the drum on top of the normal cake as it left the immersion pan. The solution was sprayed

Fig. 1—Ordinary single drum dryer with hood and exhaust

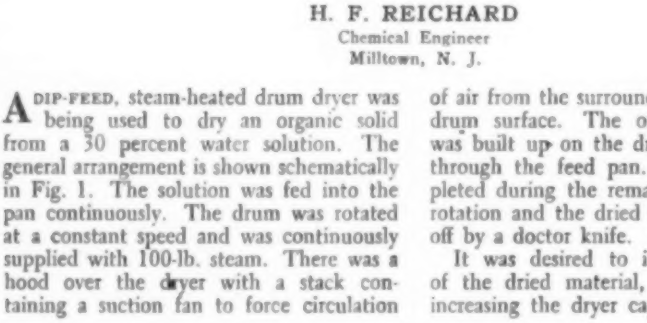
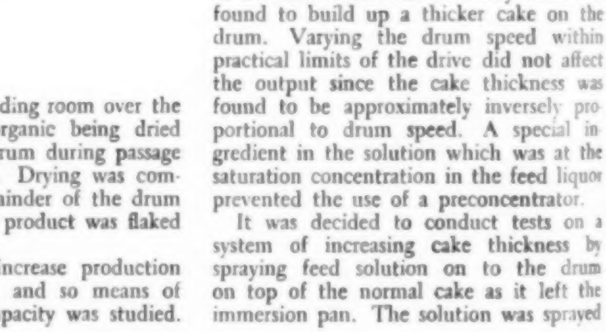
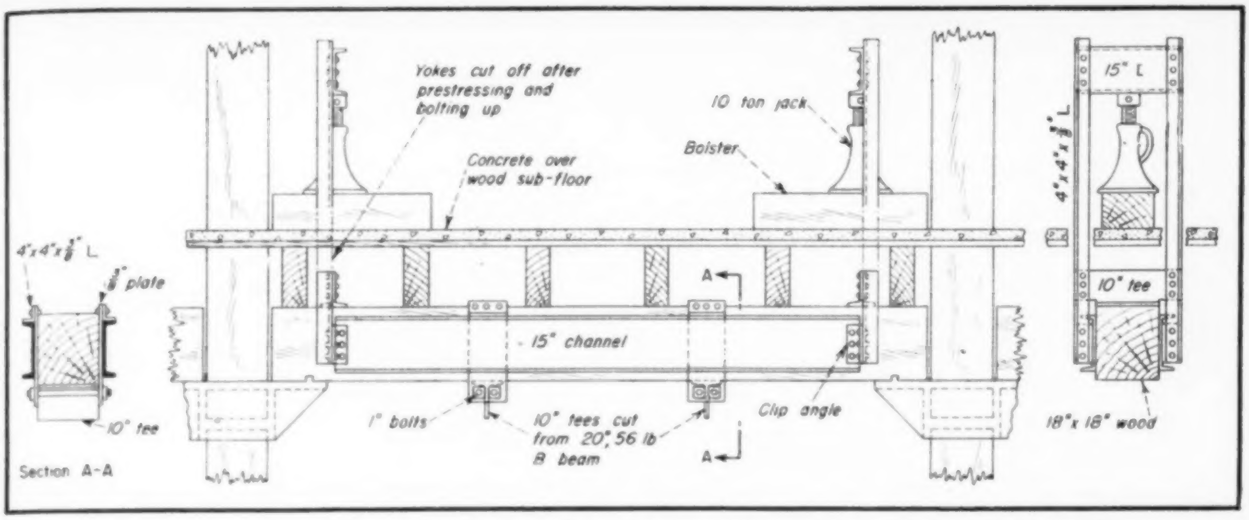


Fig. 2—Dryer with spray nozzles to double dryer output





How steel channels were pre-stressed to carry the load formerly supported by a distressed wood girder

on to a narrow strip of the drum by means of a small centrifugal pump and a piping system connected to a spray nozzle. The sprayed material was found to cling very well to the cake already formed and not to run down into the pan as was feared. Samples of the dried material were taken from this strip and were found to have satisfactory dryness and the required physical properties.

Based on the foregoing tests a system was designed embodying a centrifugal pump, eight spray nozzles, and a few short lengths of piping with valves. The schematic diagram of Fig. 2 shows the additional equipment required. With the system outlined it was possible to double the capacity of the dryer.

It may be expected that such a system will also be applicable to the double drum type of dryer which operates with a pool of feed liquor on top.

ONE WAY TO REPAIR A HEAVY WOOD GIRDER

CHESMAN A. LEE
Engineer, Darling & Co.
Chicago, Ill.

From time to time we have found it necessary to replace heavy timbers in our plant. When the plant must continue to operate at full capacity and equipment can not even be shut down for a fairly short time, let alone moved, the job is likely to be something more than a chore.

In several cases where girders have shown distress we found it possible merely to transfer the load to a pair of 15-in. channels, leaving the girders in place. Some money and much time has thus been saved. The details must be worked out to suit a particular job, but one general principle can be stated: The channels must be pre-stressed. In other words, the channels must actually carry the load, not merely stiffen the wood beam.

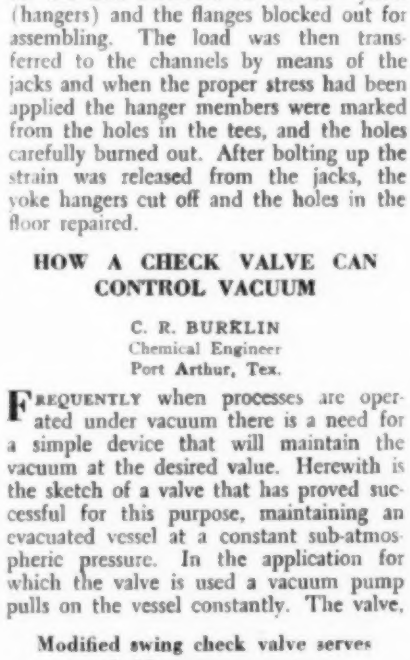
The general method of doing the job is shown in the accompanying sketch which indicates how an 18x18-in. girder that had sagged 2 in. was relieved of its load. The two channels were applied more or less like splints. First, holes were cut through the floor and yokes were set as shown, having their lower ends bolted to the channels by clip-angles. Then four 10-in. tees were cut from 20-in., 56-lb. B beams, two being used as seats under the girder to transfer the girder load to the channels. The other pair was used as follows: First they were drilled to match gage lines on the side members of the two yokes (hangers) and the flanges blocked out for assembling. The load was then transferred to the channels by means of the jacks and when the proper stress had been applied the hanger members were marked from the holes in the tees, and the holes carefully burned out. After bolting up the strain was released from the jacks, the yoke hangers cut off and the holes in the floor repaired.

HOW A CHECK VALVE CAN CONTROL VACUUM

C. R. BURKLIN
Chemical Engineer
Port Arthur, Tex.

Frequently when processes are operated under vacuum there is a need for a simple device that will maintain the vacuum at the desired value. Herewith is the sketch of a valve that has proved successful for this purpose, maintaining an evacuated vessel at a constant sub-atmospheric pressure. In the application for which the valve is used a vacuum pump pulls on the vessel constantly. The valve,

Modified swing check valve serves to hold vacuum constant



by opening or closing slightly depending on the vessel pressure, holds the pressure just at the desired point.

It will immediately be evident from the sketch how simple the device is. An ordinary swing check valve is used with extra weight added to the disk which otherwise would open too close to atmospheric pressure. This was accomplished by welding an eye to the disk and attaching a hook on which weights can be suspended. The amount of weight used is easily adjusted to hold the necessary low pressure.

MOISTURE DETERMINATION IN SOLID MATERIALS

A. O. GATES
Engineering Representative
Salt Lake City, Utah

Here is a simple, direct method for determining the moisture content of solids such as mineral raw materials, sand, clay, coal, limestone, or pulverized or lump products. It does away with the precautions usually necessary in preventing moisture content change in the sample during handling. The manipulation is so easy that any one responsible enough to take a moisture sample properly can make satisfactory moisture determinations.

The method makes use of water displacement to determine the specific volume of the sample in the wet and then in the bone dry condition, a comparison of the two specific volumes giving the moisture content. Taking water at 62.5 lb. per cu.ft., its specific volume is 2,000/62.5 = 32 cu.ft. per ton. Many common rocks have a specific gravity of 2.65 to 2.7, hence a specific volume of 12 cu.ft. per ton. A fair average for coal is 22 cu.ft. per ton; for clay, 16; and for iron ore, 7 cu.ft. per ton. Hence if the number of cubic feet occupied by a ton of the dry solid is known, this number divided into 32 gives the specific gravity. But if the material is wet, part of the apparent specific volume will be occupied by water.

In applying the method we work on the basis of 32 cc., or a multiple thereof. For less accurate work we may use 32 grams of material and a glass graduate of 50 cc. capacity. For more accurate work

we can use 320 grams of material and a graduate of 500 cc. capacity. First, fill the 50 cc. graduate to the 20 or 30 cc. mark, weigh out a 32 gram sample and pour it into the graduate, taking ordinary precautions. Read and record the water rise as so many cc. volume of the sample and its contained water. Then thoroughly dry a large enough portion of the remaining material to yield 32 grams when dry and repeat the procedure outlined above. The decrease in rise of water in the graduate is a measure of the moisture content of the original sample, the number of cc. decrease representing a moisture percentage that depends on the specific gravity of the material.

In the case of the 32 grams of dry material, each cc. rise in water level represents a specific volume of 1 cu.ft. per ton. Thus, a material of 2.65 sp.gr. will give a water rise of $32/2.65 = 12$ cc., or 12 cu.ft. per ton. Each cc. of increased water rise for the 32 gram wet sample will then represent $100/(32 - 12) = 5$ percent water in the original sample. Similarly, each cc. increased rise will represent 4 percent moisture for material of 7 cu.ft. per ton; 6.25 percent for 16 cu.ft. per ton; or 10 percent for 22 cu.ft. per ton. If a 320 gram sample is used, the same percentages will be indicated by each 10 cc. increase in water level, thus giving an additional decimal place of accuracy.

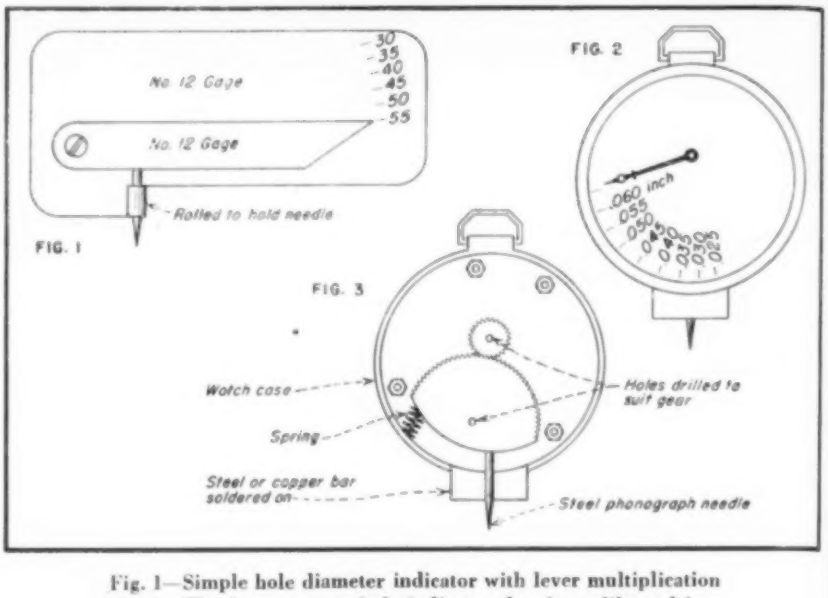


Fig. 1—Simple hole diameter indicator with lever multiplication
Fig. 2—Watch-case screen hole indicator showing calibrated face
Fig. 3—Interior of watch-case indicator showing gearing

WATERPROOF COATING FOR PLANT RECORDS

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Development Section, U. S. Rubber Co.
Institute, W. Va.

There are many instances in the operation of a chemical plant where pages of data, instructions to operators, nomographs, calibration curves, etc., receive considerable handling. These records frequently become soiled, torn, and illegible after a relatively short period of time. Thus, a recalibration must be made or, at least, another copy or print must be run off to replace the original.

To avoid such a waste of time and to guard against the loss of data which are not replaceable, it has been found practical to apply a coating of polystyrene to all records in continuous use. This is less cumbersome than the celluloid envelopes which were previously used. The latter were also unsuitable because of cracking along the folded edges, and accumulation of dirt inside and scratches outside the casing often made reading difficult.

In order to prepare any record for durable service in a few minutes, the following procedure should be used. First, the log sheet, data, or formula card to be treated is typed or written on regular paper in the normal manner. The finished page is then dipped in a solution prepared from the following formula:

Polystyrene	10 parts
Carbon Tetrachloride	90 parts

One dipping is sufficient although it is recommended that for hard wear the sheet should be dipped a second time. The coating dries in a few minutes to a flexible, leather-like finish which can be washed when and if necessary.

The polystyrene for the coating solution can be made by polymerizing styrene monomer at 100 deg. C. with a little benzoyl peroxide as catalyst. If available, scrap plastic pieces are convenient to use.

A solution of polystyrene in carbon tetrachloride is best obtained by heating the two ingredients and allowing the carbon tetrachloride to reflux for a sufficient length of time. Of course, solution will be hastened by breaking the polystyrene into small fragments before heating.

DIAMETER INDICATOR FOR SCREEN HOLES

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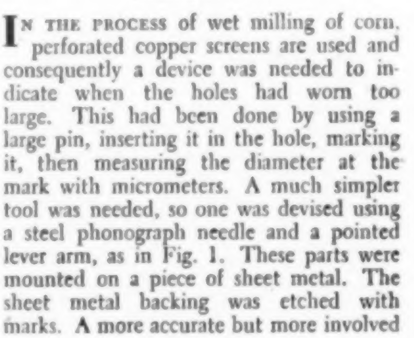
National Starch Products, Inc.
Indianapolis, Ind.

In the process of wet milling of corn, perforated copper screens are used and consequently a device was needed to indicate when the holes had worn too large. This had been done by using a large pin, inserting it in the hole, marking it, then measuring the diameter at the mark with micrometers. A much simpler tool was needed, so one was devised using a steel phonograph needle and a pointed lever arm, as in Fig. 1. These parts were mounted on a piece of sheet metal. The sheet metal backing was etched with marks. A more accurate but more involved indicator was then made by utilizing gears to amplify the movement of the needle. The one illustrated in the sketches of Fig. 2 and Fig. 3 was made from a pocket watch case, gears from an alarm clock, a phonograph needle, and a small piece of copper. A cover was also made to fit over the needle and bar.

To use the indicator it is only necessary to insert the needle in the hole and push down until the bar rests on the surface of the screen. The dial has to be calibrated with holes drilled in sheet metal or with a series of known perforated screen openings. Of course, this instrument can measure the diameter of the hole only at the surface.

Sensitive chlorine flow control valve made from scrap parts



FLOW CONTROL VALVE FOR CHLORINE GAS

RUSSELL N. THATCHER
First Lieutenant, C.E.
New York, N. Y.

Unusual design was recently employed successfully in the design of a special valve for controlling the flow of chlorine gas. Need arose, while working with bottled chlorine, for a valve that would be corrosion proof, yet would be sensitive enough to serve as a pressure and flow control device.

Accordingly, the writer designed and built the valve illustrated from scrap. In the drawing the most important part indicated is a pliable rubber "pencil" that was cut from an old automobile tire and then shaped on a bench grinder. The remainder of the valve was of brass, which is preferably silver plated. Ordinary black friction tape was used for the stem packing. It will be noted that the stem, handwheel, packing box and bonnet were taken from an old valve.

In operation against a full cylinder pressure of 100 lb. per sq.in. the toughness and flexibility of the rubber "pencil" provide such extremely sensitive control that gas flow at a pressure as low as 0.5 lb. per sq.in. is easily maintained.

REPORT ON.....

PETROLEUM BYPRODUCTS

A Big Factor in Organic Chemical Industry

Recognition of petroleum as a basic raw material for organic synthesis has resulted from the wartime achievements of the chemical and petroleum refining industries. Brought about partly by the shortage of coal-derived products, this new role of petroleum is the outgrowth of nearly three decades of slow (at first) but steady development, dating commercially from the World War I production of petroleum derived toluene. Traditionally one of the leaders, the technological advances of the petroleum refining industry were reported in *Chem.&Met.* June 1945. A further summary by B. H. Weil, Gulf Research and Development Co., Pittsburgh, Pa., (present address: Engineering Experiment Station, Georgia School of Technology, Atlanta, Ga.) shows how petroleum byproducts have become an important factor in the organic chemical industry.

PETROLEUM chemical developments in World War II, startling as they have seemed, are simply sound and logical outgrowths of the research and commercial endeavors which preceded that period. Outstanding among the wartime achievements is the mass production of butadiene, styrene, toluene, cumene, isobutane, and isobutane-olefin alkylates, and the providing of vast quantities of olefinic gases for the synthesis of other chemicals and chemical products such as synthetic rubbers and plastics.

Petroleum, in the sense in which it is often used in the chemical industry, means the complex solution of paraffinic, isoparaffinic, naphthenic, aromatic, and condensed aromatic hydrocarbons which comprises the crude oil obtained from the earth, as well as the natural gases which accompany it or are obtained from fields of their own. It also means the distilled and thermally or catalytically transmuted products of the refinery. Naturally, crude oil in its entirety is seldom used for chemical synthesis, but almost all of its fractions and refined products have at sometime been considered as chemical raw materials.

Chief among the petroleum hydrocarbons, which are currently the building blocks for organic synthesis, are the lighter paraffins and olefins. This is true for two reasons: (1) Olefins yield products which are themselves versatile chemical raw materials, and (2) they are abundantly available in refinery gases or may be easily produced from them or from natural gas. Two types of refinery gases are available: (1) Those obtained from the distillation of crude oils, and (2) gases obtained from cracking plants and other refining operations. It has been pointed out that gases from thermal cracking may contain from 12 to 25 percent of C_2-C_4 olefins and that a typical cracked gas would yield 18.4 percent olefins, 5.8 percent ethylene, 10.5 percent propylene, 1.4 percent butene-1, 0.2 percent butene-2, and 0.8 percent isobutylene.[28]

Catalytic cracking operations loom as even more important sources of gaseous olefins. Data on once-through fluid catalytic cracking operations, for example, may be interpreted to indicate that some 9 percent of the C_3-and-lighter fraction consists of ethylene, while the propylene content may approximate 30 percent of the total (sometimes as high as 51 percent). Since yields of this fraction range from 6.0 to 14.5 percent (by weight) of the charge, there can be little question that vast quantities of light olefinic "building blocks" will be available.[30] The same data on fluid catalytic cracking reveals that C_4 olefins comprise about 32 percent of the C_4 fraction, which in turn amounts to 5.6-12.8 percent by weight of the charge. Catalytic cracking operations, during the war, provided most of the butylenes required by the aviation gasoline and synthetic rubber programs.

Methane is abundantly available in natural and refinery gases. While it is still used chiefly as a fuel, its growing number of chemical process uses presages a period where limitations may possibly be placed on "low-utility" fuel applications. Proved reserves, however, of natural gas continue at present to increase in size and probably approach 200 trillion cubic feet in quantity.

It should be noted, too, that the petroleum chemical industry is not dependent upon petroleum reserves. Total chemical consumption does not exceed 3 to 4 percent of current petroleum production, and, even when and if world production becomes depleted, petroleum substitutes pro-

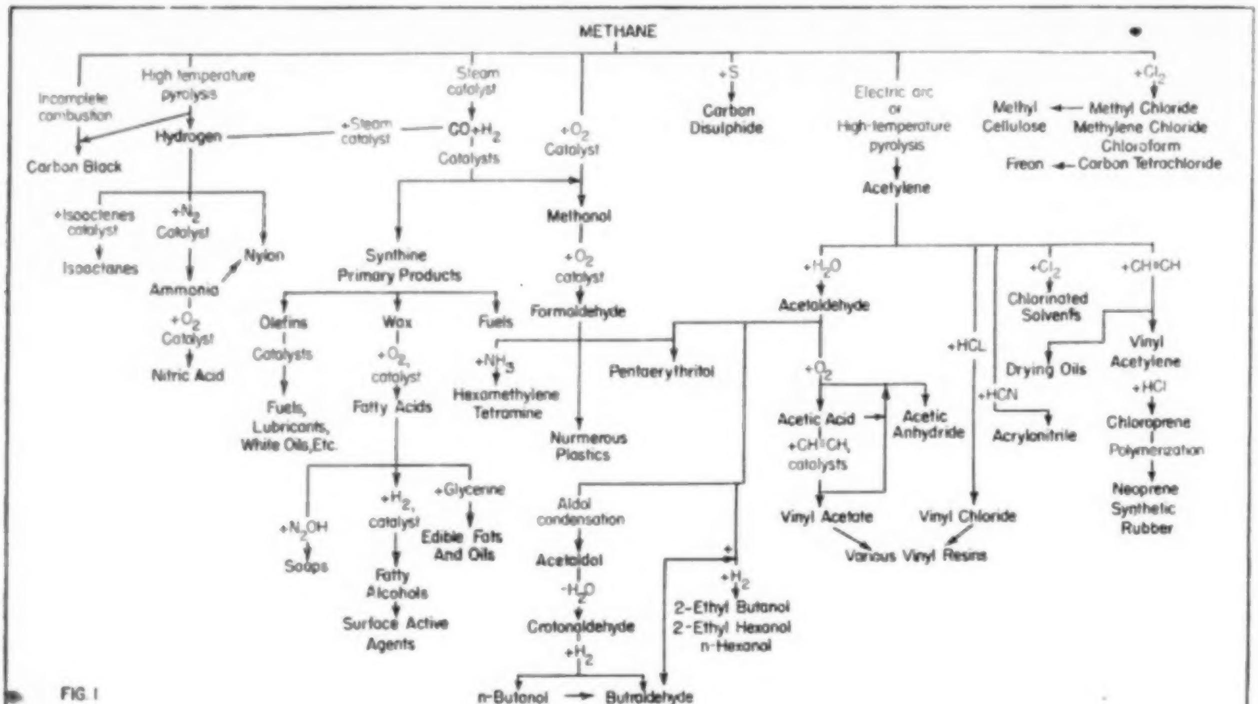


Fig. 1—Methane has become an important source of synthetic organics

duced from coal and oil shales will be accompanied by an abundance of the same chemical raw materials now obtainable from petroleum operations.

The light hydrocarbons are by no means the only chemical raw materials obtained from petroleum. Numerous surface-active agents are being prepared from olefins present in (or produced from) kerosene fractions. Cracked paraffin waxes have been used here and abroad for the synthesis of high-quality lubricants. Reports from missions sent to Germany to study its wartime technology have confirmed prewar information on the oxidation of paraffin wax to yield fatty acids, fatty alcohols, and even edible fats and oils.

There are also a number of borderline petroleum products which are essentially chemicals in themselves. These include the naphthenic acids, sulphonic acids, petroleum cresylic acids, and the several hydrocarbons which have been separated from petroleum fractions. Cyclohexane is an example of the latter; it has been reported that Du Pont will extract this hydrocarbon from naphthas and will use it as a raw material for nylon in its new Orange, Tex., nylon plant.

METHANE SYNTHETICS

Returning to the light hydrocarbons, Figs. 1 to 3 will serve to illustrate the extent to which these substances have been used as chemical raw materials. By no means are all of the present commercial derivatives shown; ethylene, for example, is said to have several hundred.

Fig. 1 is of particular interest in that it shows one of the extensive derivatives of methane. The chlorinated derivatives shown have been known for some time, although some of their uses are comparatively recent commercial developments.

Acetylene is not yet a large-scale petroleum derivative, but it is certainly a potential one. German wartime research is said to have perfected the use of the electric arc for its production from methane, while a possibly similar development has been underway at the University of Texas (the Schoch process) and is now said to be undergoing pilot-plant research by Commercial Solvents. Petroleum Chemicals, Inc., is also interested in the commercial production of acetylene, having announced plans, prior to the war, to use the Wulff regenerative furnace process, developed through the pilot-plant stage by Tennessee-Eastman.*

There has never been any doubt as to the chemical versatility of acetylene. It was, for a long time, the chief (and almost only) source of such important chemicals as acetaldehyde and its derivatives; chlorinated solvents such as tetrachlorethane, trichlorethylene, perchlorethylene, and hexachlorethylene; vinyl chloride and its derivative resins; and Neoprene synthetic rubber. These chemical products are still produced from it in very large quantities. Abroad, acetaldehyde produced from acetylene has been used for the production of butadiene.

No cost figures for production from petroleum or natural gas have ever been made public, but rumor has it that acetylene so produced, in large quantities near cheap sources of supply, might cost less than 5c. per lb. Since the normal price for acetylene from calcium carbide is reported to approximate 12c. per lb., it is easy to see why so much recent attention has been given to a substance whose derivatives probably exceed in quantity one billion pounds per year.

Methane, in the past ten years, has threatened to supplant coal as a source of hydrogen and carbon monoxide for chemical purposes; in fact, there is no question that a major part of the more than 24,000,000 cu.ft. of hydrogen produced last year was derived from methane. A large part of the wartime expansion in methanol production capacity represents plants built to use methane, while the huge expansion in ammonia-production facilities made use of the several methods for producing hydrogen from methane. The interchangeability of ammonia and methanol plants was repeatedly proved during the recent war, and it is not at all unlikely that methanol will be produced in excess ammonia plants, reportedly at prices considerably below the recent range of 31 to 51c. per gal.

The Synthine (Fischer-Tropsch) process is a chemical synthesis which will probably make extensive use of natural gas in the next few years, at least one commercial plant (that of Hydrocarbon Research, Inc.) having already been announced. Its chief products will probably be hydrocarbons for use as gasoline and diesel fuels, and long-chain olefins for the synthesis of high-grade lubricants, but variations in the process can yield quantities of oxygenated chemicals,[7] in fact, it would be all too easy to flood the market with such chemicals.

During the war, Germany is said to have

produced a large proportion of its soaps and edible oils from fatty acids derived from the oxidation of Synthine slack waxes. Of more immediate interest here, however, is the use of these fatty acids for the production of long-chain fatty alcohols, now obtained chiefly from such natural waxes as sperm oil or from the hydrogenation of natural-oil-derived fatty acids.[8]

Carbon black, of course, is a long-acknowledged methane derivative. Wartime-expanded capacity now exceeds 1,200,000,000 lb. per year, divided almost equally between the channel and furnace blacks, the latter being particularly applicable for use with GR-S synthetic rubber. The future of these products is not particularly clear; demand will probably decrease when and if natural rubber replaces synthetic rubber in appreciable quantities, since products made from the latter require more carbon black than is normally used in natural rubber compounding.

Numerous other chemical products are produced from methane. Carbon bisulphide is a distinct possibility. Methane oxidation (along with the oxidation of other light hydrocarbons) will yield increasing quantities of formaldehyde and its commercially-interesting derivatives (which include the phenolic, urea, and melamine resins and casein plastics). The bulk of formaldehyde production, however, will probably continue to come from the oxidation of methanol.

Fig. 2 is indicative of the bewildering complexity already apparent in the commercial synthesis of chemicals from ethylene. This is particularly true for the versatile derivatives of ethylene chlorohydrin, ethylene oxide, and ethylene dichloride, since many of the other chemicals can be produced from any of these.

ETHYLENE DERIVATIVES

The story of ethylene chlorohydrin and its most famous derivative, ethylene glycol, is already a familiar part of the history of organic chemistry. For many years the company which commercialized these chemicals and their numerous derivatives, the Carbide and Carbon Chemicals Corp., has been the acknowledged leader in the field of chemicals from petroleum, although several petroleum and chemical companies are now vying for a share of recognition.

Ethylene oxide, produced by the controlled catalytic oxidation of ethylene, is reported to be gradually displacing ethylene chlorohydrin as a raw material. Initial patent control of this product was held by Carbide and Carbon, but a Supreme Court decision regarding a reissued patent has evidently opened the field to several competitors who may also be using ethylene chlorhydrin, since basic patents have expired. The economic advantages of ethylene oxide over ethylene chlorohydrin are not altogether clear. It seems probable that demands are high enough to require the operation of plants using both intermediates, although new plants presumably will make use of ethylene oxide (which, incidentally, may be produced from the chlorohydrin).

It is impossible to show, in Fig. 2, all of the some 200 chemical products which Carbide and Carbon produces, largely from ethylene. Among the more important are ethyl acholol (many millions of gal. per year), butadiene (145,000 tons per year), and, as mentioned, the numerous derivatives of ethylene oxide, ethylene chlorohydrin, and ethylene dichloride.

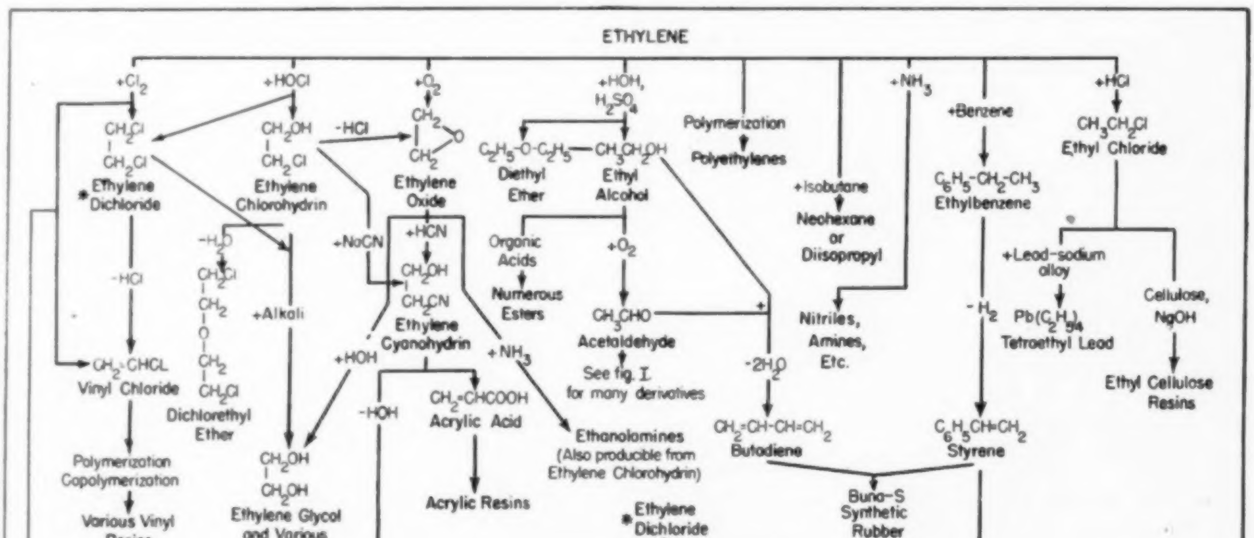
The glycol esters and ethers are remarkable antifreezes, solvents, plasticizers, emulsifying agents, and resin intermediates. The glycol-ethers, the Cellosolves and Carbitols, are especially remarkable solvents because of their bifunctionality.

No less notable are the ethanolamines, used in great quantities in gas purification for the removal or concentration of hydrogen sulphide or carbon dioxide. Dichloroethyl ether, besides being a remarkable solvent, is used in the synthesis of one type of Thiokol synthetic rubber.

Du Pont and Rohm & Haas are the chief leaders in the field of the acrylic resins, which make use of polymethyl acrylate and polymethyl methacrylate (synthesis shown in Fig. 3). Acrylonitrile, used in large quantities in the buna-N type synthetic rubbers, is synthesized commercially in several ways, three of which are shown in Figs. 1 and 2.

It may be assumed that most of the

Fig. 2—Many important derivatives are commercially produced from ethylene



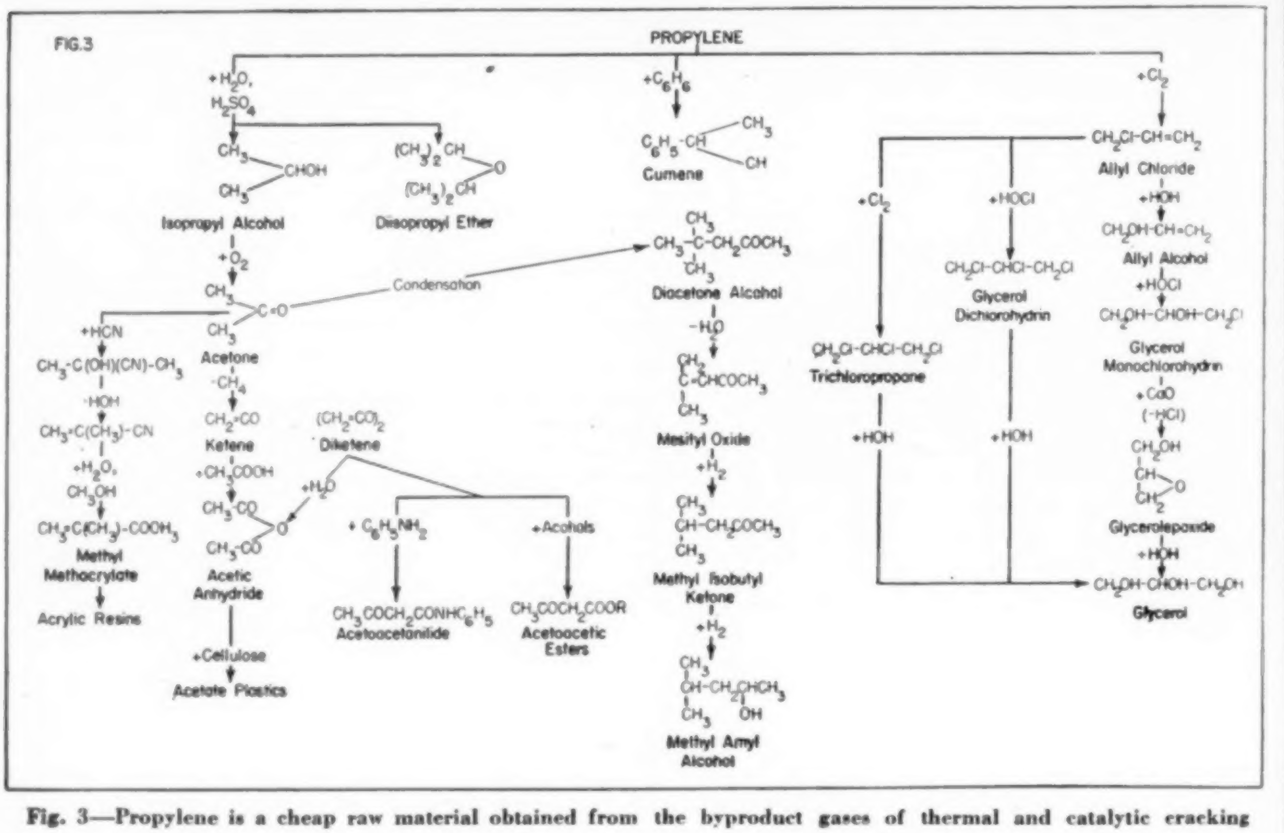


Fig. 3—Propylene is a cheap raw material obtained from the byproduct gases of thermal and catalytic cracking

peacetime production of styrene will come from petroleum ethylene, since ethylene derived from alcohol (as was necessary in several wartime plants) is considerably more expensive. Whether butadiene produced from petroleum-derived ethyl alcohol can compete with that from the dehydrogenation of petroleum butylene is as yet unanswered, but competition might be close unless it becomes more profitable to sell the alcohol for other purposes. Low-cost butylenes will probably maintain their present lead.

Ethyl chloride has long been an important petroleum derivative, much used for the production of tetraethyl lead. Synthesis from ethylene has gradually been supplanting the former alcohol-based process, although the latter was much in use during the war because ethylene was in heavy demand for other purposes. The ethyl cellulose resins are a comparatively recent, but fairly large-scale, development.

Polyethylene resins, pioneered in Great Britain, have recently been introduced in this country by Du Pont and Carbide and Carbon. Those vinyl resins derived from vinyl chloride (see also Fig. 1) are now produced in large quantities. In fact, production of all vinyl resins probably approximated 175,000,000 lb. in 1944, about half of which was vinyl chloride.

Many derivatives of acetaldehyde are obtainable from ethylene as well as from methane-derived acetylene. Since several years before the war, various n-butanol producers have been using ethyl alcohol (or ethylene) as raw material, and other acetaldehyde derivatives are also being so produced.

Ethylene, as Fig. 2 attests, is a prolific source of chemicals—at present, by far the most extensively used of all the petroleum raw materials. Not many chemical manufacturers can obtain it in sufficient quantities by separation from cracked refinery gases, but it is readily and cheaply prepared by such processes as the pyrolysis (demethanation) of propane, propylene being a byproduct of such reactions.

CHEMICALS FROM PROPYLENE

It is at once apparent from Fig. 3 that propylene is not used in as many ways as ethylene. Nevertheless, many important chemicals are so derived, probably the most important being isopropyl alcohol; some 75,000,000 gal. were so produced in 1944.

Besides its important solvent uses, isopropyl alcohol is used in vast quantities for the production of acetone, of which some 385,000,000 lb. may be produced this year, largely by this method. Acetone, in turn, has become the chief source of acetic anhydride, and the low prices made possible by the processes involved have been largely responsible for the rapid growth in the cellulose acetate plastic and rayon fields.

The polymethyl methacrylate resins, largely derived from acetone, have become the leaders in the "acrylic" field, some 35,000,000 lb. having been produced in 1944, chiefly for use in transparent enclosures on airplanes. Since 1941 production probably did not exceed 5,000,000 lb., it remains to be seen if new uses can be developed to take advantage of the greatly-expanded capacity.

Acetone is also a source of diacetone alcohol, an important solvent and chemical intermediate; its demethanation product, diketene, is also an important intermediate for the synthesis of numerous compounds which in turn are important sources of "fine chemicals."

Fig. 3 also shows a series of reactions developed through the pilot-plant stage by the Shell Development Co.[17] Glycerol has probably not yet been produced on a commercial scale, but two of its intermediates, allyl chloride and allyl alcohol, are now manufactured in a plant built by Shell. Besides other uses as chemical intermediates, these substances (or at least allyl alcohol) are chiefly used in the synthesis of newly-developed transparent allyl resins such as Allymer C.R.-39.

Cumene (isopropylbenzene) production, of course, has been a purely wartime development, though on a very large scale. This substances has been used used as a "rich-mixture" additive in aviation gasolines, and it has long been thought that the higher prices involved in so obtaining bursts of speed and quicker takeoffs will obviate the use of such agents in peacetime aviation fuels. Cumene is a rather interesting chemical intermediate, however, and at least small quantities may be used for the production of various derivatives. For example, styrene may be pro-

duced from cumene by high-temperature pyrolysis (**demethanation**).

Most other propylene derivatives are not produced in very large quantities. As noted, however, propylene may be cheaply obtained from the byproduct gases of thermal and catalytic cracking, propane pyrolysis, and the catalytic dehydrogenation of propane, and it seems likely to be extensively used in the future.

BUTANE AND BUTYLENE

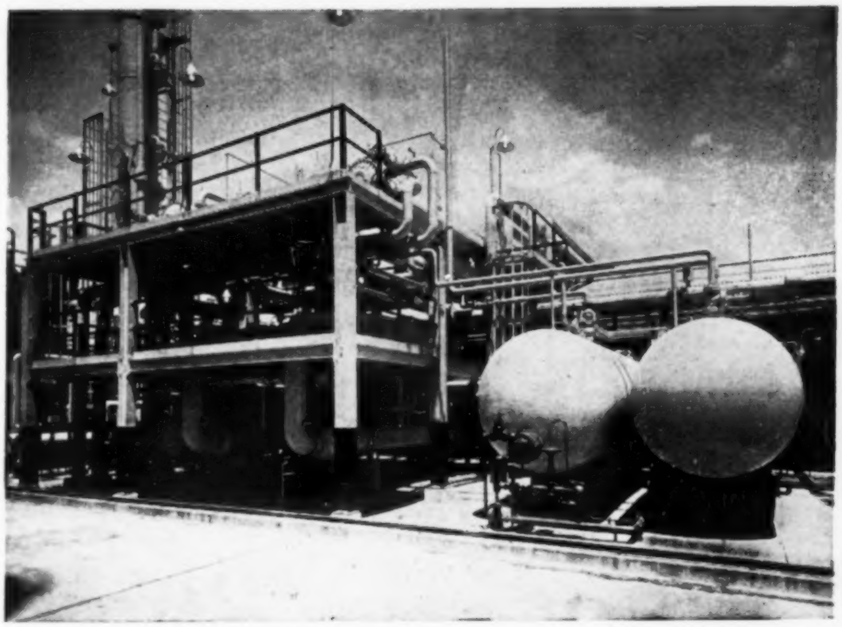
One of the chief present uses of the C_4 fraction of petroleum gases is the production of quality fuels. Chemical synthesis principles are involved and many of these processes are so selective as to require the use of catalysts. Peacetime aviation requirements, however, will certainly be only a fraction of the more than 200,000 bbl. per day wartime production of these blending agents, although large quantities may go into premium fuels.

Butadiene, of course, is certainly the most important chemical derivative of the C_4 group, since some several hundred thousand tons per year of rated production capacity require the butylenes as raw material, while some 60,000 tons per year of capacity uses n-butane itself as the starting material. It seems highly likely that butadiene produced from these substances will be in heavy demand for some time to come, since natural rubber (even if it eventually supplants GR-S) will not be available in quantities sufficient for all needs for at least a few years, and an improved GR-S from low-cost petroleum butadiene may well be able to hold an appreciable part of the elastomer market.

Isobutylene is also a good source of chemical materials.[18] These include methallyl chloride, methallyl alcohol, methacrolein, isobutyl alcohol, isobutyl chloride, tertiary butyl chloride, tertiary butyl alcohol, isobutyric acid, para tertiary butylphenol, etc. The alkylation of phenols with isobutylene yields products possessing valuable anti-oxident properties.[18]

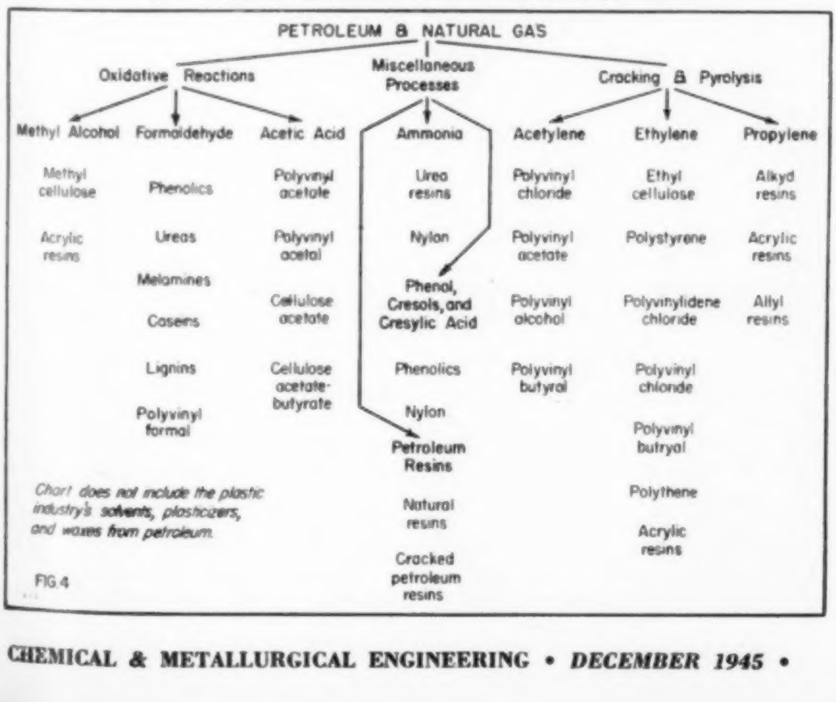
In addition, isobutylene may be polymerized to yield heavy liquids which are important as lubricant additives (or even synthetic lubricants) and solids such as Vistanex, an interesting rubber-like polymer. When 2 to 4 percent of a diolefin such as isoprene or butadiene are copolymerized with isobutylene, butyl synthetic rubber is obtained. This substance, among the cheapest of the synthetic rubbers and now produced to the extent of some 63,000 long tons per year, seems to have an interesting future, at least for use in inner-tubes.

Butene-1 and butene-2 have other uses than for butadiene synthesis, naturally. Considerable quantities of secondary butyl alcohol are currently being obtained, and, in turn, this alcohol is used to produce large amounts of secondary butyl acetate and methyl ethyl ketone (perhaps 10,000,000 gal. per year of the latter).



Allyl chloride plant of the Shell Development Co. at Houston, Tex.

Fig. 4—Basic reactions and their resulting products



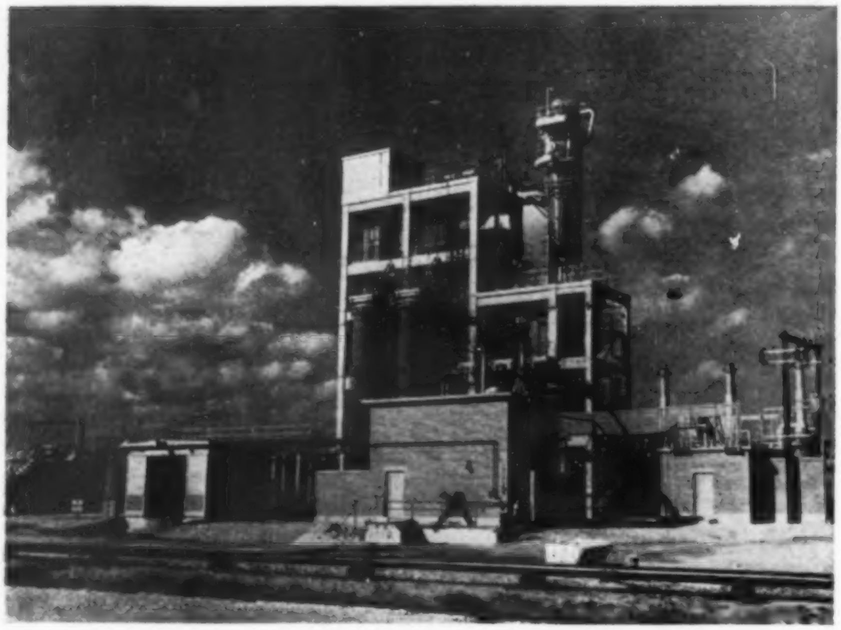
PENTANE DERIVATIVES

The published chemistry of this field is probably almost as well known as that of the ethylene compounds, because of the concentrated research and commercial achievements of Sharples Chemicals, Inc., a pioneer in the commercial chlorination of paraffin hydrocarbons. N-butyl chloride and n-hexyl chloride are produced in addition to mixed amyl chlorides and dichloro and polychloro pentanes.

The mixed amyl chlorides are chiefly used for the synthesis of the other amyl compounds, such as the amyl alcohols and their esters. These are available in pure forms, but large quantities of mixed amyl alcohols and mixed amyl acetates are sold, chiefly for use in the formulation of nitrocellulose lacquers. Oddly enough, the primary alcohols and esters predominate in the mixtures. Other pentane derivatives produced by Sharples include amyl phenols, amyl naphthalenes, amyl benzenes, amyl ether, amylenes, amyl mercaptans and sulphides as well as numerous amines of other hydrocarbons.

It is evident then that the petroleum chemicals are already far too prolific to cover in detail in a single article. Many of the chemicals which have had to be disregarded here have been discussed in previous articles on the subject (see references 10, 13, 16, 18), as well as in various comprehensive texts such as that prepared by Ellis.[8]

Major fields of application of the pe-



Ethylbenzene is produced by Dow from petroleum-derived ethylene

troleum chemicals are probably six in number: resins and plastics, synthetic rubbers, synthetic textile fibers and finishing agents, solvents and plasticizers, detergents and lubricants, and aviation gasoline.[9]

MAJOR USES

Plastics—Production capacity probably now exceeds 1,000,000,000 lb. per year since net resin content alone was 784,137,000 lb. in 1944, and it is no mere coincidence that most of the important new plastics (polyvinylidene chloride and its copolymers, polyethylene, the allyl resins, ethyl cellulose, the vinyl resins, and polystyrene) are derived from intermediates chiefly synthesized from petroleum.[11, 18]

Synthetic Rubbers—These have already been discussed in some detail. Those obtained in large part from petroleum include GR-S (buna-S), buna-N, butyl, Vistanex, and Thiokol, in addition to numerous rubber-like plastics such as specially-prepared polyvinyl chloride and polyvinyl butyral.

Synthetic Fibers—Turning to the synthetic textile fibers, it is at once apparent that petroleum chemicals play their part in the synthesis of almost every fiber: hydrogen, ammonia, and cyclohexane in nylon synthesis; vinyl chloride and vinyl acetate in the preparation of Vinyon fibers; vinylidene chloride in the synthesis of saran; etc. Even the semi-synthetic fibers derived from cellulose owe much to petroleum chemicals, for the continued increase in cellulose acetate rayon production is directly attributable to low-cost acetic anhydride from petroleum sources. Cellulose acetate-butyrate monofilaments also may use petroleum-derived butyric acid.

Much has been heard in recent months concerning coatings and finishing agents for fibers.[10] The former are generally resins and plastics, often derived from petroleum, while the latter include such synthetic and semi-synthetic resinous finishes as urea-formaldehyde, acrylic resins, ethyl cellulose, methyl cellulose, and various complex agents such as Du Pont's "Zelan." Melamine-formaldehyde resins have been mentioned as shrink-proofing agents for wool.

Solvents—This subject is of common interest to many industries. In addition to hydrocarbon solvents prepared directly from petroleum fractions, petroleum hydrocarbons are used in the synthesis of numerous solvents (see Figs. 1-3). From methane, for example, may be obtained methyl alcohol, methyl esters, methylene chloride, chloroform, carbon tetrachloride, and isobutyl alcohol. Ethylene yields the countless glycols and glycol esters, ethers, ether-alcohols, and ether-esters as well as the ethanolamines, ethyl ether, ethyl alcohol, ethyl esters, n-butanol, acetone, 2-ethyl hexanol, and 2-ethyl butanol.

All of the lower hydrocarbons, especially the olefins, are excellent raw materials for the synthesis of solvents. Others include isopropyl alcohol, alkyl acetates, butyl alcohol, methyl ethyl ketone, and the amyl chlorides, alcohols, and esters. Propane is used to synthesize nitro-paraffins.

Synthetic Detergents—The role of the petroleum hydrocarbons in the synthesis of detergents and synthetic lubricants is interesting and significant. Tariff Commission figures for 1943 show that of the 40,095,665 lb. of "cyclic" synthetic detergents, wetting agents, and similar surface-active materials produced in that year, some 33,224,097 lb. were "sulfonated petroleum compounds," while 6,681,376 lb. of the 45,944,276 lb. of "noncyclic" surface-active agents also produced were sulfonated petroleum materials.

Typical of the cyclic detergents produced from petroleum are the Nacconols, long chain (10-12 carbon atom) alkyl aryl sulfonates, which derive their olefins from a kerosene cut. The Tergitols, neutralized alkyl sulphates of alcohols such as hexadecanol and heptadecanol (produced by condensing butyraldehyde with specific ketones), are representative of the latter group. Reference to the basic chemistry of these and similar complex detergents are given by Wakeman and Weil.[10]

Synthetic detergents, "super-soaps," were much in use by the Armed Forces during the recent year. The cessation of hostilities brings back to grocers' shelves such synthetic detergents as Swirl and Vel, and others will follow. It has even been rumored that petroleum-derived detergents, cheaply produced on a large scale, may give soap a battle in many of its fields of application.

In regard to synthetic lubricants, these also find use for the long hydrocarbon chains which are either available from cracked waxes and the like or can be created by the polymerization of olefins or by the Sythine process. Many of the processes involved have been recently summarized by Weil.[14]

Aviation Gasoline—It is not common practice to pay much attention (outside the automotive and petroleum industries) to chemicals if they are prepared only to be "destroyed" (by combustion), but the interesting details of the syntheses (largely from petroleum gases) involved in the preparation of blending agents (isooctanes, neohexane, diisopropyl, cumene, etc.) for aviation gasoline have commanded attention for several years. Commercial details are recounted in a recent *Chem & Met* report.[2]

PROCESSES

The unit processes involved in the synthesis of chemicals from petroleum are identical to those used by the chemical industry as a whole. Hydrogenation, dehydrogenation, alkylation, isomerization, polymerization, cyclization, oxidation, chlorination, amination, and sufonation reactions are in widespread use. In some cases, of course, the actual process is not a simple one. The pyrolysis of propane, for example, has been used to yield ethylene (by demethanation) and propylene (by dehydrogenation); with higher temperatures and shorter contact times, much acetylene is obtained.

A better example is provided by one of the processes now in use for the synthesis of acetic anhydride, as shown in Fig. 3. Propylene is hydrated (catalytically) to yield isopropanol, which is then dehydrogenated (or oxidized) to yield acetone. The acetone is then thermally demethanated to yield ketene or diketene. The former yields acetic anhydride upon reaction with acetic acid, while the latter

may be reacted with a quantitative proportion of water for the same purpose.

Whatever the reaction or reactions involved, the synthesis of chemicals from petroleum present few problems that are not encountered in the other operations of the chemical industry. Purification of raw materials, it is true, must often be performed and is sometimes the limiting economic factor,[4] but even this is done by adaptations of standard chemical and physical processes. Modern operations of the petroleum refining industry as a whole have shown it to belong to the chemical industry; so does the manufacture of petroleum chemicals.

BASIC ECONOMICS

A recent survey[10] of the factors which must be considered by a petroleum refiner who would become a manufacturer of chemicals presents some points which are pertinent to any producer, chemical companies included:

1. A synthetic, no matter how cheap, cannot displace a byproduct, but can only supplement it. Glycerol, for example, is a byproduct of soap manufacture, and cannot be dislodged by the synthetic material.
2. No matter how easy it may be to manufacture a hydrocarbon derivative, there can be no profit in it unless a market exists or can be developed. Tertiary butyl alcohol, for example, was first produced some 17 years ago, but operations had to be discontinued because of lack of a market. Manufacture was resumed only after technologic advances created a demand for this chemical. In this connection, it should be noted that rarely has a new chemical been produced without ultimately creating a demand for itself. The interim between its supply and demand, however, may be of such duration that only a financially strong company can afford to invest in the development of a substantial market. Certain resins, moreover, like those derived from methyl vinyl ketone or from sulphur dioxide and olefins, were developed on a semi-commercial scale several years ago, but are as yet unsuccessful. Creation of a market in these instances depends upon improvement of the physical and chemical properties of the products—a slow, costly, and as yet unachieved research project.
3. A small expanding market is more attractive than a large, static one. The historical evolution of acetic anhydride is an excellent illustration of this fact.
4. The ideal products are those that have expanding markets and that are rapidly destroyed in use (petroleum's bulk products are of this type). There are very few hydrocarbon derivatives in this category at the moment.
5. The most profitable lines of research are those directed at low-cost manufacture of intermediates which are now expensive but which are required for products of high quality. Certain highly attractive resins, for example, while recently made in large volume for military uses, are probably too expensive to find wide peacetime application in competition with phenolics.

Petroleum companies, of course, find themselves in a different category than chemical companies when it comes to entering petroleum chemical production. It has been pointed out that, in general, a petroleum company may advisedly contemplate entering the field of chemical derivatives only when one or more of the following situations prevail:

1. It has available a large volume of a certain raw material required for the manufacture of a chemical consumed in considerable quantities.
2. It has at hand a unique raw material capable of serving in the production of a new and potentially important industrial chemical.
3. It is wasting large volumes of a byproduct, such as natural gas or refinery sludges, which might be converted economically to useful materials. The chemical utilization of wastes is an essential part of a national program of conservation.
4. It is able to develop a strong patent position in the production of a chemical of present or potential large-volume demand.
5. It can economically manufacture additives required to enhance the value of its own bulk products, or can produce chemicals which can be sold in place of others currently purchased.
6. It possesses sales and technical service staffs with well-established contacts with another industry which is a potential consumer of its chemical products.

Once it has been determined that at least one of these conditions prevails, other questions must be settled. How well adapted is existing equipment to the manufacture of chemical derivatives? To what extent should a plant undertake new construction? How far should a company go in converting its raw materials into finished chemical products? What idiosyncrasies of chemical economics need be considered? What form of company organization should be set up to manufacture and market chemical derivatives? What kind of research program is necessary?

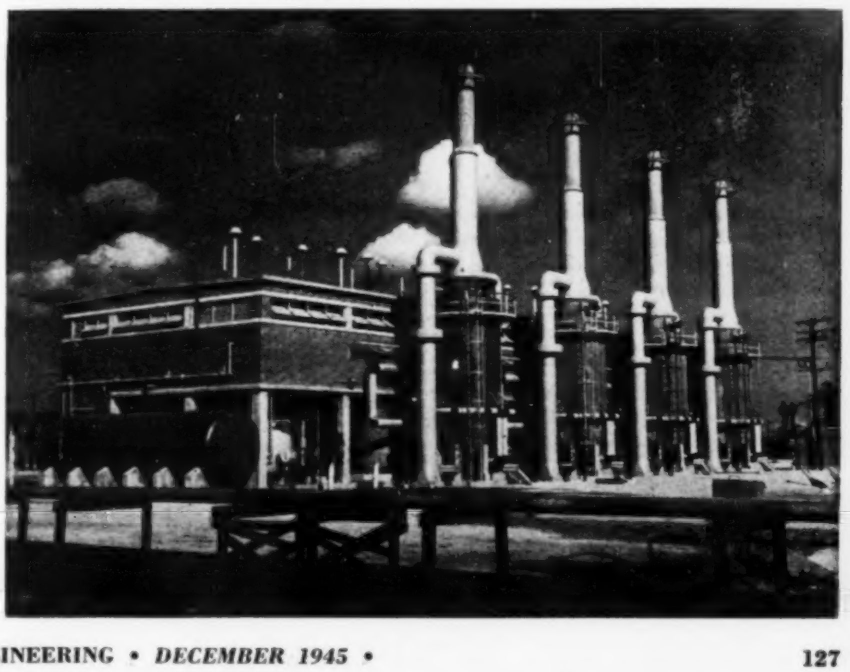
Chemical companies are not affected by many of the above factors. Their sales and advertising staffs are already acquainted with the complexities involved in chemical marketing; their executives are well informed on the intricate relationships between chemicals and the interplay of prices and uses.

COMBINES FORMED

It is small wonder, therefore, that many petroleum companies have seen fit to enter organic chemical production by creating joint subsidiaries with an already-established chemical manufacturer. In this group are the Hycar Chemical Co. (a Phillips Petroleum Co.-B. F. Goodrich Co. combine), Petroleum Chemicals, Inc. (Continental Oil Co.-Air Reduction Co.), and the Jefferson Chemical Co. (recently formed by The Texas Co. and the American Cyanamid Co.).

Prime exponents among the petroleum companies which have entered the field through wholly-owned subsidiaries or divisions are the Standard Oil Co. of N. J., the Shell Oil Co., the Standard Oil Co. of Calif., and the Standard Oil Co. of Ind. Activity is apparent through-

Styrene is made from ethylbenzene by the Dow Chemical Co. at Velasco, Tex.



U. S. Production of Certain Petroleum Chemicals in Tons[1]

	1943	1944
Acetic acid, synthetic	146,271	146,305
Acetic anhydride	230,213	247,761
Alkyl nitriles	13,099	....
Ammonia (100%)	543,879[2]	543,398
Amyl acetates, total	5,749	6,930
n-Amyl acetate (90%)	3,233	5,253
Amyl alcohols, total	6,036	9,263
Butyl alcohols, total	....	123,222
n-Butanol	....	75,160
n-Butyl acetate	32,150	34,993
Carbon tetrachloride	....	104,901
Chloroform	4,339	4,372
Chloroparaffins	24,867	21,790
Dichlorodifluoromethane (Freon-12)	....	20,000
Diethyl ether	32,924	34,878
Ethyl acetate (85%)	51,800	64,098
Ethylene dichloride	57,847	....
Ethylene glycol	93,417	101,225
Hydrogen (Million cu. ft.)	22,327[2]	24,327[2]
Isopropanol (M gal.)	....	80,000
Maleic acid and anhydride	4,012	3,911
Methanol, synthetic (M gal. 100%)	64,958[2]	71,280[2]
Methyl chloride	5,726	12,140
Methylene chloride (all grades)	3,309	....
Methyl formate	....	5
Perchlorethylene	26,477	....
Surface-active agents (noncyclic)	22,972	38,995
Sulfonated petroleum compounds	3,342	....
Surface-active agents (cyclic)	20,048	37,133
Sulfonated petroleum compounds	16,612	14,760

[1] Data compiled from reports of the Tariff Commission, Bureau of Census, and *Chem. & Met. Eng.* 52, No. 2 (1945). Some of these figures include production from nonpetroleum sources. All figures given in tons unless otherwise noted. [2] Figures do not include production from government plants. Such production probably would double the figures for ammonia and would add about 30,000,000 gal. to those for methanol.

out the entire petroleum industry, especially since many companies, because of the war, have already been engaged in chemical manufacturing through the production of butadiene and toluene.

The chemical industry is by no means lagging behind. The past achievements of Carbide and Carbon, Dow, Du Pont, Monsanto, Sharples, and others are not causing these companies to rest on their laurels. The Celanese Corp., for example, has recently completed a plant to produce several oxygenated hydrocarbons from natural gas. As mentioned, Du Pont is building a nylon plant in Texas, so as to use petroleum-derived cyclohexane and hydrogen.

The question has been asked: "How extensive, really, is the present manufacture of chemicals from petroleum?" This, of course, is a question to which only those government agencies entrusted with the compilation of statistics could accurately reply, but an indirect answer is obtainable through a glance at published figures.

According to a Tariff Commission report for 1944, a total of 3,001,496,000 lb. of chemical raw materials (in addition to toluene and certain other items) were derived from petroleum in that year, an increase of approximately 1,500,000,000 lb. over 1943. This production included a large proportion of the 29,052,000 gal. of crude cresylic acids produced from all sources (13,915,900 lb. were produced from petroleum in 1943), 28,462,000 lb. of naphthenic acids, 488,945,000 lb. of butadiene, 202,380,000 lb. of 1-butene and 2-butene mixture, 272,188,000 lb. of ethylene, 214,555,000 lb. of C_4 hydrocarbons, 569,087,000 lb. of all other hydrocarbons, and 871,240,000 lb. of benzene and all other crudes from petroleum and petroleum-derived hydrocarbons.

Toluene production is indeterminable at present, because of the cessation of military demands, but 1,490,000 bbls. were produced in 1944 from all petroleum plants not under Ordnance control, in addition to 800,000 bbl. of aviation-grade toluene, and, early in 1945, it was stated that all petroleum plants were producing at a rate of over 4,300,000 bbls. per year (180,000,000 gal.). Since prewar demands did not overtax the capacity of coal-tar distillates (about 30,000,000 gal. per year), it is obvious that few of the petroleum units will continue in operation (for this purpose, at least).

Returning to statistics, the table shows a summary of certain additional information. Besides this, it has been estimated[4] that the following chemical quantities were produced from petroleum in 1944: isopropanol, 75,000,000 gal.; methyl alcohol, 3,000,000 gal.; and methyl ethyl ketone, 10,000,000 gal.[1] About 25 percent of the country's supply of butanol is said to have been produced from petroleum constituents last year, and it is believed that acetone production (which comes largely from isopropanol) will approximate 385,000,000 lbs. in 1945; 328,428,000 lbs. were produced from isopropanol in 1944.

It might be noted that more than 7,000,000 tons of synthetic organic chemicals are said to have been produced last year,[1] compared with 6,200,000 tons in 1943, and that more than 5,000,000 tons of the 1944 production consisted of noncyclic chemicals; preliminary figures indicate that these estimates were probably exceeded.[3] Taking all these figures into consideration, it is certainly safe to say that the current production of chemicals from petroleum (and natural gas) runs into the several millions of tons per year.

FUTURE OUTLOOK

It seems highly likely that the output of petroleum chemicals will continue to rise. Such wartime developed tonnage lost through the return of peace (toluene production and, eventually, part of that of butadiene and styrene) will be more than overbalanced by the output of new plants whose construction has been delayed by the war. New companies continue to enter the field, sometimes through regrouping of present subdivisions.

Competition has always been the keynote of the chemical industry. Patent structures may offer protection for some short time, but, eventually, a competitor (or the company itself) will either develop substitutes or better methods of manufacture.

The petroleum industry, in large part, has been hesitant to enter a field in which economic cross-currents are so numerous, but the steady diminution in profits on standard products such as fuels and lubricants has alerted executive quarters to the possibility of profitable production of chemicals and specialties (some of which are also chemicals).

There now seems to be little fear, however, that petroleum companies will "run chemical companies out of business." Signs of the times point to a growth in cooperative enterprises, which add to the profits of both. In any case, petroleum is now an acknowledged raw material for chemical synthesis, and, as such, will continue to command close attention.

Reprints of this report are available at 25 cents per copy. Address the Editorial Department, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

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PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

PIPE LINE STRAINER

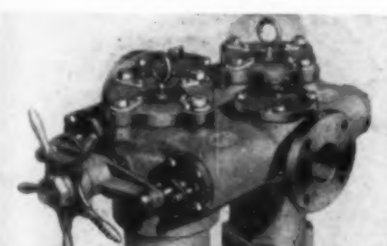
To MAINTAIN continuous flow in pipe lines when it is desired to strain the material flowing through, the J. A. Zern Mfg. Co., Erie, Pa., has announced a duplex, vertical-chamber disk-type strainer that is operated by a large hand wheel, so constructed as to reverse the valves simultaneously with minimum pressure drop. Full capacity flow is assured at all positions of the operating hand wheel. The strainer baskets are set eccentrically with respect to the basket chamber, a feature said to make the flow section proportional to the flow needs at all points, thus minimizing pressure drop. The chambers are provided with removable covers for easy access to permit cleaning. Large hand holes above each valve assembly permit servicing the valves without removing the strainer. The device is available in cast bronze, steel, semi-steel and cast iron, with the basket of perforated brass, Monel, or other specified metal.

WATER JET PUMP

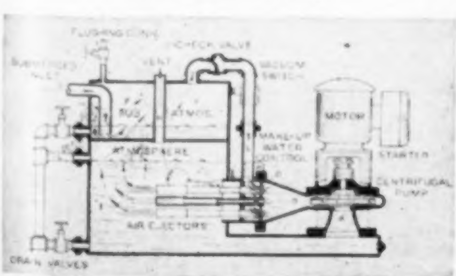
ALREADY used successfully in the heating field, a water jet vacuum pump manufactured by Whittington Pump & Engineering Co., 245 S. Meridian St., Indianapolis 4, Ind., is now being introduced into the industrial vacuum process field. The pump is claimed to develop a vacuum of 29 in. Hg when water at 60 deg. F. is employed for the jet. The device is simple in construction, consisting of a vertical centrifugal pump that recirculates water through a group of specially designed jets that exert a powerful suction effect upon a sub-atmospheric chamber which is part of the unit. Since it is not oil-sealed, the unit is unaffected by moisture, nor is it affected by dust in the air or gas being evacuated. The unit is produced in a wide range of sizes, in single and duplex models available in standard copper-bearing steel, or special metal construction. In the accompanying illustration water is drawn into the pump at *A*, discharged at *B*, entering jets *C*. Air is drawn through the ports at *D* from the vacuum line *E*. Sub-atmospheric pressure is maintained in chamber *M* which is connected to evacuated equipment at *G*. Air is vented through *H*, water is recirculated from tank *I* through *J* and make-up water is provided by a float control *K*.

An interesting variation of this idea is the company's Hydro-Scavenger, a truck-mounted vacuum tank equipped with a vacuum pump of this type, and provided with a hose for removing sludges and other difficult materials from sumps prior to discharge to waste or process, under pressure also provided by the machine.

Duplex pipe line strainer



Water jet vacuum pump

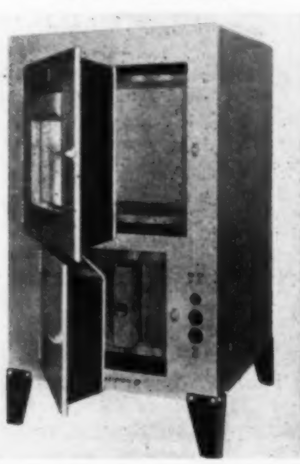


COLD CABINET

TWO SIZES, 1 cu. ft. and 8 cu. ft. capacity, are provided in a new series of Vari-Temp cold cabinets recently introduced by the Precision Scientific Co., 1750 North Springfield Ave., Chicago 47, Ill. The cabinet operates with dry ice and has been designed to meet the requirements for cold tests at temperatures between −90 deg. F. and +220 deg. F. The chamber, which is readily accessible through a vertical front-opening door, is sufficiently large to hold the various pieces of apparatus used in making the Youngs Modulus test on natural and synthetic elastomers at normal and subnormal temperatures, according to A.S.T.M. specification D-797. Apparatus and specimens under test are readily visible at all times through the seven-pane sealed window unit which prevents condensation and frosting. Illumination is provided by a fluorescent light which is shielded to prevent both direct and indirect glare, enabling thermometers and instruments in any part of the chamber to be read easily from outside the chamber. For temperatures above atmospheric a heating unit is provided. To insure constancy of temperature, air is circulated to maintain the temperature within plus or minus 1 deg. F.

Starting from an ambient temperature of 75 deg. F., it is claimed that a temperature of −75 deg. F. can be reached in 4½ hours. Separate thermostats are provided for low temperature and for high temperature control.

Dry ice cold cabinet



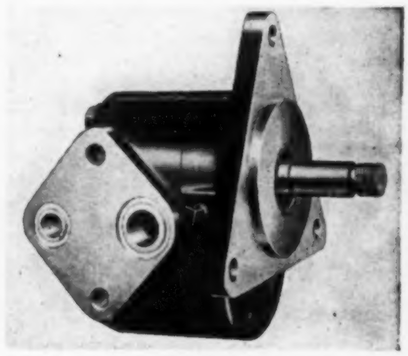
HYDRAULIC PUMP

VOLUMETRIC efficiencies of 95 percent and better at 3,000 r.p.m., under pressures as high as 1,500 lb. per sq. in. are claimed for an improved gear-type hydraulic pump developed by Pesco Products Co., 11610 Euclid Ave., Cleveland 6, Ohio. The capacity rating is 3.5 g.p.m. at 1,500 r.p.m., or 7 g.p.m. at 3,000 r.p.m. Intended for wide range of uses, the pump is adapted to various methods of mounting. Its weight is 4.4 lb.

ELECTRONIC GAGE

ULTRA-RAPID gaging of small parts of various materials such as plastics, ceramics, glass, paper or metal is accomplished automatically by a new electronic gaging instrument developed by the Autotron Co., P. O. Box 722, Danville, Ill. The machine is claimed to gage depths of holes, external lengths and outside diameters to extremely close tolerances with high precision, operating at speeds upwards of 3,300 pieces per hour. Depending on the service, the machine may often be hopper fed into a loading chute from which point the machine automatically feeds the pieces into inspec-

General purpose hydraulic pump



tion position. In operation the dimension being measured must be within the tolerance for which the machine is set, otherwise the piece will automatically be rejected. Tolerances as small as 0.0001 in. can be employed.

BAR STOCK VALVE

New bar stock straight-through and angle valves in carbon and stainless steel for flow control in high pressure lines handling air, gas, oil, gasoline or other liquids, have been announced by the Kitson Co., 1500 Walnut St., Philadelphia 2, Pa. A feature of the new line of valves is that when a valve is opened and under pressure, the stuffing box can readily be repacked.

PRESSURE ROTARY PUMP

Capacities from 60 to 480 g.p.h., at pressures up to 1,000 lb., depending on the viscosity of the liquid handled, are provided by a new mechanical-seal rotary pump which operates through a direct drive at motor speeds of 1,200 to 1,800 r.p.m. The pump is manufactured by the Bump Pump Co., LaCrosse, Wis. If desired, the pump can be provided with conventional packing instead of mechanical seals. Standard models have standard bronze sleeve bearings, or ball bearings throughout. They can be provided with a bypass and pressure relief valve. The pump can be mounted in any position and can be built in any suitable metal such as cast iron, bronze or stainless steel.

DRY ICE LIQUEFIER

To assist various classes of carbon dioxide consumers, such as carbon dioxide fire extinguisher users, and others, the Mathieson Alkali Works, 60 East 42nd St., New York 17, N. Y., has developed a device which transforms solid carbon dioxide into liquid form. Known as the "Jumbo," the Mathieson liquefier consists essentially of a tank 6 ft. 8 in. high and 34 in. in diameter, made of special steel and welded throughout. It has a capacity of 20 full size blocks (1,000 lb.) of dry ice. Use of uncrushed blocks of dry ice saves labor and reduces evaporation loss, it is claimed. Engineered according to A.S.M.E. specifications and approved by Hartford Steam Boiler Inspection & Insurance Co., the device is charged with blocks of dry ice which are dropped through a 15-in. circular opening at the top. After closing, water is run down the outside surface from a perforated ring near the top to provide the heat required for melting. There are no moving parts and the device operates without compressor or refrigeration unit, electric heating coils or sensitive control equipment. Pressure release devices are all that is necessary for control.

PLASTICS TESTER

A combination flexure tool and deflectometer for testing molded plastics, plastic laminates and woods is being produced by the Southwark Division of Baldwin Locomotive Works, Philadelphia 42, Pa. This instrument will make tests in bending in accordance with latest Federal specifications and those of the A.S.T.M., and will fit any testing machine. The deflectometer measures deflection from the center of the specimen and conveys this to a stress-strain recorder which then gives the load deflection curve. To accommodate different kinds of materials the instrument is provided with adjustable magnification of the deflection in multiples from 5 to 200 times.

IMPREGNATED WOOD

Plastic impregnation of wood to develop a high degree of acid resistance is the feature of Acidbar, a new product of Koppers Wood Preserving Technical Dept., Orrville, Ohio. According to the manufacturer, one application in a spray type pickling machine to Southern yellow pine enabled the wood to remain firm and sound after 18 months' service in 10 to 15 percent sulphuric acid at temperatures up to 180 deg. F. Untreated wood in this same application is said to have lasted only two to three weeks. Similar results were observed in fume ducts employed on the same machine. Untreated wood fell apart after two weeks' exposure.

This material is also being used for the construction of stacks to exhaust acid vapors and for covering concrete floors and foundations under an elevated acid tank to protect the concrete against acid spillage. The plastic treating material is liquefied by high temperature and forced into the wood under high pressure for an impregnation of 10 to 20 hr., after which the compound sets-up to a semi-solid distributed in the cells of the wood as it is allowed to cool. The treatment increases the weight and hardness of the wood, giving it a black surface which need not be painted. The properties of the material make it suitable for many applications under severe service conditions of temperatures as high as 180 deg. F.

Wood thus treated can be installed with ordinary woodworking tools. In applications where wood expansion or shrinkage are detrimental, the treatment substantially decreases changes of shape and dimensions when subject to alternate wetting and drying. Wear resistance is also increased by the increased hardness and other properties given to the wood by its plastic content.

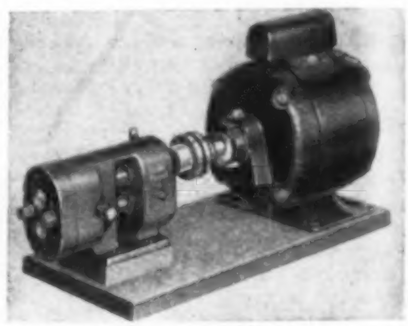
STEEL STOOL

Steel stools, available in five heights and 40 models for many industrial uses, are now being marketed by Lyon Metal Products, Inc., Aurora, Ill. Designed from a physiological standpoint, the stools are said to aid materially in reducing employee fatigue. All welded design, nonbreakable construction and large, comfortable seats are features.

HIGH TENSILE ELECTRODE

Welding of groove butt joints and horizontal and flat fillets in the higher tensile steels is the function of the new Fleetweld 11-HT electrode manufactured by the Lincoln Electric Co., Cleveland, Ohio. It is claimed as a result of exhaustive field tests that the quality of groove

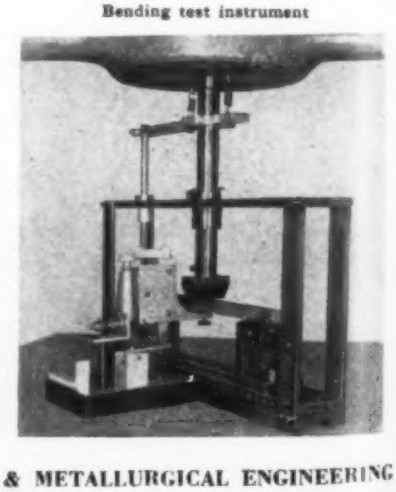
Improved high pressure valve



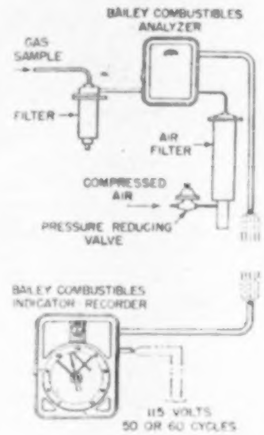
Low-capacity high-pressure pump

Liquefier for dry ice

Bending test instrument



Aging bath for rubber and elastomers



Combustibles recorder controller

NL-945 (F) low-temperature test chamber

New vertical motor

butt joints made with these new electrodes is exceptionally good, while fillet welds so made are extremely smooth, with a flat face. The electrode is claimed to give remarkably low spatter loss and to yield a steady arc, with welds free from undercut. It is claimed further that low-alloy, high-tensile steel can be welded as easily and as rapidly with the new electrode as mild steels can be welded with ordinary electrodes. Tensile strengths in the range from 75,000 to 80,000 lb. per sq. in. the as-welded condition, and elongations of 19 to 23 percent are claimed.

AGING BATH

To facilitate aging tests on rubber and elastomers in oils or liquids in test tubes, according to the requirements of A. S. T. M. Tests D-471 and D-735, the Precision Scientific Co., 1750 N. Springfield Ave., Chicago 47, Ill., has introduced an oil-immersion aging bath having a capacity of 24 test tubes of 38-mm. diameter. The bath is capable of maintaining temperatures between 35 and 200 deg. C. with an accuracy of plus or minus 1 deg. C. It is heated by steel sheath immersion heaters controlled by an adjustable hydraulic thermostat. A ball bearing, fully inclosed, resilient mounted motor stirrer is supplied to provide circulation. The interior of the bath is of stainless steel with 3 in. of glass wool insulation on sides and bottom. If desired, the bath can also be used for aging materials in air in test tubes.

COMBUSTIBLES RECORDER

An automatic analyzer and recorder for indicating, recording and controlling the combustibles content of gaseous mixtures has recently been developed by the Bailey Meter Co., Cleveland 10, Ohio. Designed to apply precision control to furnace atmospheres and chemical processes, the instrument is said to have been used successfully in petroleum, chemical and other industries. It provides a continuous and almost instantaneous record, responsive to changes of 0.05 percent combustibles, with sustained accuracies said to be within 0.25 percent.

In operation a continuous gas sample is mixed with compressed air and burned on a catalyst-filament which reaches a temperature proportional to the combustible content. Since the filament resistance is a function of temperature, a simple resistance bridge connected to a null-balance electronic recorder completes the installation. Either pneumatic or electric control may be employed, and instruments may be provided in both one- and two-pen recorders. The latter uses separate analyzers so as not to impair recording speed by switching.

TEST CABINETS

Two new cabinets for low-temperature testing under a range of humidities have been developed by Northern Laboratories, Ltd., 3-10 27th Ave., Long Island City 2, N. Y. Model NL-945 (F) has a temperature range of —100 deg. F. to +200 deg. F., and will dissipate 1 kw. of heat input at —100 deg. F. Its vacuum range is from sea level to 80,000 ft., and humidities from 15 to 95 percent can be maintained. Model NL-950 (F) operates in the temperature range from —50 deg. C., to +60 deg. C., maintaining humidity conditions from 10 to 95 percent relative humidity. Both types are fully automatic in operation.

VERTICAL MOTOR

A newcomer in the line of protected type alternating-current motors manufactured by the Crocker-Wheeler Division of Joshua Hendy Iron Works, Ampere, N. J., is a vertical drip-proof motor rated for 40 deg. C. temperature rise in continuous duty, with a 15 percent service factor. At present the sizes available include a NEMA "B" flange type mounting up to and including "284" frame, and a NEMA "C" face type mounting up to and including the "326" frame. All ventilating openings are shielded against entrance of dripping liquids or falling particles. Oversize ball bearings are provided to carry thrust in addition to that of the rotor and longer bearing life is said to be assured though the use of the company's patented centrifugal bearing seal.

WIND-UP MACHINE

For the constant-speed, constant-tension winding of continuous materials such as large diameter wire, cable, and hose, the Industrial Oven Engineering Co., 11621 Detroit Ave., Cleveland, Ohio, has developed a new heavy-duty wind-up machine, larger and for heavier service than the machine developed several years ago by this firm. Flexible materials up to 1¼ in. in diameter can be handled. Standard speed ranges are 25 to 150, 40 to 200, and 60 to 240 ft. per min., with tension values from 5 to 1,000 lb. The machine is motor driven and requires no outside source of power or synchronization. The standard model employs a 42-in. reel but a special size to take a 60-in. reel can be supplied. Mobile models are available.

ENGINE EFFICIENCY RECORD

What is claimed to be a new world record for engine thermal efficiency is claimed to have been obtained recently during routine tests of one of the regular Type JF turbo-charged gas-diesel engines manufactured by Cooper-Bessemer Corp., Mt. Vernon, Ohio. In this test efficiencies in excess of 40 percent were obtained, it is claimed, which is higher than any thermal efficiency record previously set by steam, gas, gasoline, gas turbine or diesel engines. According to the manufacturer the best previous records were established by diesel engines, although such engines usually operate in a range between 32 and 36 percent.

SELENIUM RECTIFIER

Capacities from 25 mils up to hundreds of amperes are obtainable in a line of selenium rectifiers recently improved by Radio Receptor Co., 251 West 19th St., New York, N. Y. Constructed of iron and other metals for the Armed Forces during the war, these units have been redesigned in aluminum and have been provided with a method of sealing the unit hermetically. The wide range of capacities

available is said to make these rectifers suitable for a large number of industrial applications in the conversion of alternating to direct current.

VACUUM FILLER

Filling containers with liquids of all kinds is the function of a new stainless steel vacuum filler recently introduced by the Scientific Filter Co., New York, N. Y. Heavily built, the unit employs a filling head which is lowered to the filling position by operation of a foot pedal. The filling head locks automatically while in the filling position so that the operator is free to attend to the handling of his empty and filled containers, while those in the machine are filling up. As soon as these are filled, a foot trip is released which immediately disengages the filling head. At the same time the automatic foam control and drip control carry away any foam or drip that might develop. Empty bottles which have in the meantime been placed in position on the filling track are now pushed into the filling position, at the same time pushing out of the way the bottles that have already been filled. The filler is said to be easily adjustable, while the spouts themselves can readily be changed to accommodate different container openings.

BREATHING APPARATUS

Developed for high-altitude flying, the Air-Pak, manufactured by Scott Aviation Corp., Lancaster, N. Y., is now available for fire fighting and general industrial use, employing normal breathing air—not oxygen—stored under pressure in a compressed air cylinder. The apparatus is easy to use and provides special features such as a device enabling the user to conserve compressed air and breathe through the open end of the low-pressure hose until entering the danger zone. The Willson mask used employs shatterproof lenses cushioned in rubber for full unobstructed vision in all directions. The breathing air is drawn into the mask over the lenses, eliminating fogging. Two types of compressed air cylinder are available, a back-pack model and a sling type (illustrated).

PRESSURE DETECTOR

Utilizing the same principle as was employed in this company's electronic strain gage for many wartime applications, the Southwark division of Baldwin Locomotive Works, Philadelphia, Pa., has developed the new SR-4 pressure sensitive device which is used to convert the pressure of a liquid or gas into an electrical measurement for indicating, recording or controlling. The device is available in several ranges from 0 to 20,000 lb. per sq. in., and it is claimed to offer extreme accuracy, $\frac{1}{4}$ of 1 percent of full scale.

Heart of the device is a very fine filament wire bonded to a hollow metal core against which the gas or liquid pressure to be measured is exerted. As the pressure increases this filament stretches, thus changing its diameter, and hence its resistance. The amount of current flowing through the filament therefore varies with the pressure and can indicate on a dial or actuate a control system. The filament is said to be sensitive to a stretch of the metal core of only one millionth of an inch. The instrument is hermetically sealed and provided with a built-in compensator to cancel out the effect of any extraneous force such as temperature.

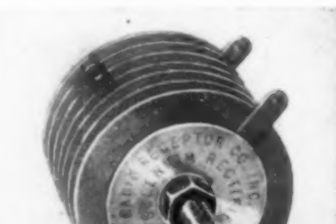
HARD OVERLAY ROD

For hard-surfacing applications employing the company's principle of low-temperature welding, Eutectic Welding Alloys, Inc., 40 Worth St., New York 13, N. Y., has developed two rods, Eute-Chrom 11 for acetylene welding, and EuteChrom 12 for carbon arc and metallic arc welding. Each rod produces a deposit of weld metal containing in a matrix of tough steel innumerable small particles of an alloy of extremely hard and tough characteristics for maximum wearing performance. The rod for use with the oxyacetylene torch operates smoothly at a cherry red heat, it is claimed, while the arc coating rod, for either a.c. or d.c., is provided with a special coating to insure smooth and spatter-proof flow.

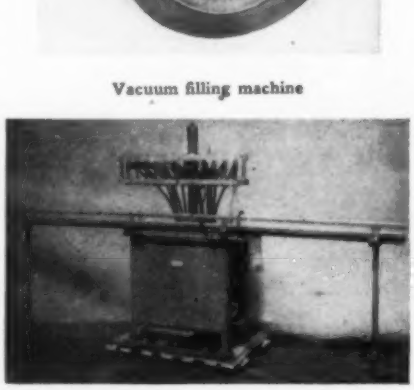
INDUSTRIAL HOSE COUPLING

For the coupling of industrial hose in $\frac{1}{2}$ and $\frac{3}{4}$ in. sizes to faucets, the E. B. Wiggins Oil Tool Co., 3424 East Olympic Blvd., Los Angeles 23, Calif., has developed a quick-acting hose coupling containing only two moving parts. The device is built to withstand pressure to 600 lb. per sq. in. and is made of aluminum. A threaded end section is attached permanently to any standard threaded faucet. The portion attached to the hose is provided with a knurled ring, motion of which operates a set of hinged dogs that grip the faucet section. Moving the ring back against pressure of a spring permits the dogs to swing open for uncoupling of the hose. The shank on the faucet section rides inside a rubber gasket in the ring section to prevent leakage.

Improved selenium rectifier



Vacuum filling machine



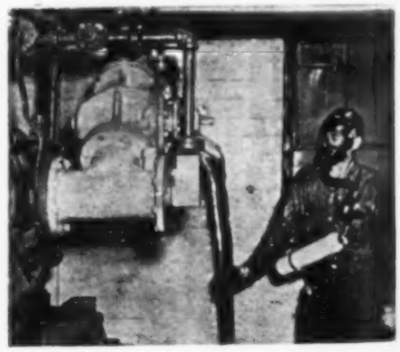
CUTTING ELECTRODE

Unskilled workmen, it is claimed, can successfully cut metal after only 10 minutes instruction through use of the new Ellpro electrode developed by Ellwood Products Co., Ellwood City, Pa. This electrode was designed to permit greatly increased speed in metal cutting and particularly for use in underwater cutting at unlimited depths. The electrode is made of steel in the form of a hollow tube, with an adhesive coating which prevents it from sticking to the cutting surface. It is used with oxygen, permitting safety to the user at any depth under water. More than two years of experimentation was required in developing the coating finally chosen. Speed of operation is said to be the major advantage. A molten arc is obtained the instant the electrode is placed against the surface to be cut, employing either alternating or direct current.

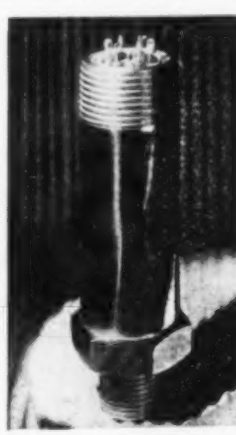
BRUSH CLEANER

Maintenance departments will welcome a new centrifugal method for rapid cleaning of paint brushes which is being offered by the Nashway Co. Ltd., 1401 West Pershing Road, Chicago 9, Ill. Known as the "Spin-A-Brush" method, it employs a hand or motor operated chuck which grasps the paint brush handle. It is only necessary to squash the brush for a moment in the cleaning liquid, after which the brush is spun rapidly for a few seconds above the surface of the liquid but still within the cleaning liquid container. The operation is then repeated and the brush is then fully cleaned, according to the manufacturer.

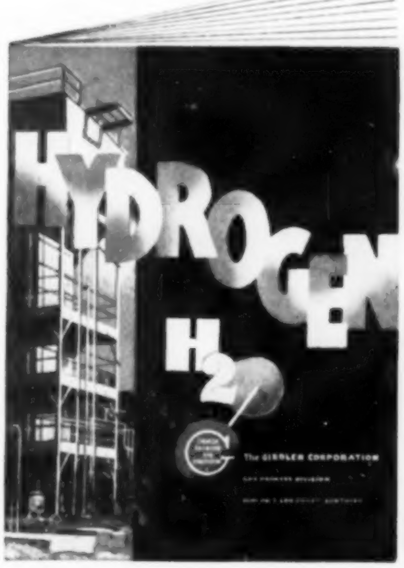
Self-contained breathing apparatus



Electronic pressure sensitive device



IF YOU ARE INTERESTED IN THE PRODUCTION OR PURIFICATION OF HYDROGEN . . .



GET THIS BOOK

WHAT hydrogen manufacturing method will meet your requirements most effectively and economically? To help you find out, Girdler engineers have compacted pertinent facts about commercially useful hydrogen processes into one streamlined, easily read book. Write for a copy.

The book is an especially valuable addition to your reference library because it contains a comprehensive account of the new Girdler HYGIRTOL PLANT for the production of high purity hydrogen from hydrocarbons and steam. In many localities, such plants are making it possible to produce extremely pure hydrogen on a remarkably profitable basis.

A HYGIRTOL Plant may be operated on a continuous basis at 0 to 100 per cent of capacity. Changes in production rate are simple to make. The process employed is quiet and clean and uses raw materials that are readily available, easily handled and low in cost. Indoor or outdoor installations require little space and a minimum amount of operating attention.

Girdler hydrogen plant engineering ability is backed by versatile, practical experience with other processes for gas manufacture, purification, separation, and dehydration. ***Consult us on your*** *problems concerning hydrogen sulphide, carbon monoxide, carbon dioxide, inert and controlled atmospheres, natural gas, refinery gases, liquid hydrocarbons, hydrogen, nitrogen.* ***Originators of the*** *Girbotol Process.*

CHEMICAL ENGINEERS AND CONSTRUCTORS

The GIRDLER CORPORATION

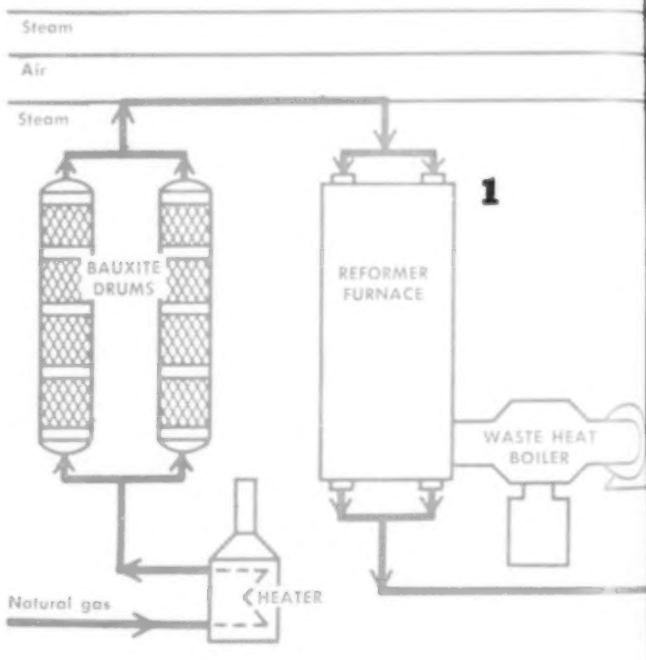
Gas Processes Division, Dept. CM-12, Louisville 1, Ky.
New York Office, 150 Broadway, New York 7, N. Y.

SYNTHETIC AMMONIA

Three synthetic ammonia plants in which the hydrogen is obtained from natural gas were constructed and put into operation during the war. One of these DPC plants was located at Lake Charles, La., and was operated by Mathieson Alkali Works.

On reaching the plant the natural gas goes to a purification system in which sulphur is removed. The gas is preheated and passed through towers filled with bauxite. Sulphur-free gas from the scrubbers goes to a reformer furnace. Methane in the gas is dissociated into hydrogen, carbon monoxide and carbon dioxide. From the reformer furnace, the dissociated methane passes to a combustion chamber to which preheated steam, methane, and air are also supplied, and as much as possible of the undissociated methane and part of the carbon monoxide are consumed. Air is introduced in such volume that the mixture leaving the chamber will have the required percentage of nitrogen for the ammonia production. The residual carbon monoxide is converted to dioxide in a shift converter and the gas is compressed. Carbon dioxide is removed in a Gerbitol system using monoethanolamine and carbon monoxide absorbed in a pressure vessel containing cuprous and cupric formates. After being compressed the gas passes to ammonia converters. The gas leaving the converters contains about 16 percent ammonia. It passes through a converter outlet cooler where water reduces the temperature to 100 deg. F. In a second cooler refrigeration further reduces the temperature to 75 deg. F. liquefying part of the ammonia. The gases and liquid anhydrous ammonia enter the primary separator in which the liquid ammonia collects in the bottom and is drained off from the circulating synthesis. The gases leaving the top of the separator, containing 4.5 percent ammonia, combine with fresh synthesis gas and are returned to the converter. The liquid ammonia is stored in insulated Hortonspheres. The pressure is controlled by refrigeration. From these storage vessels ammonia can be pumped to tank cars or to the nearby ammonium nitrate plant. For a more detailed account of the process refer to pp. 94-96.

**This synthetic ammonia plant at Lake Charles, La.,
by Mathieson Alkali obtains its hydrogen from**



A
Chem & Met
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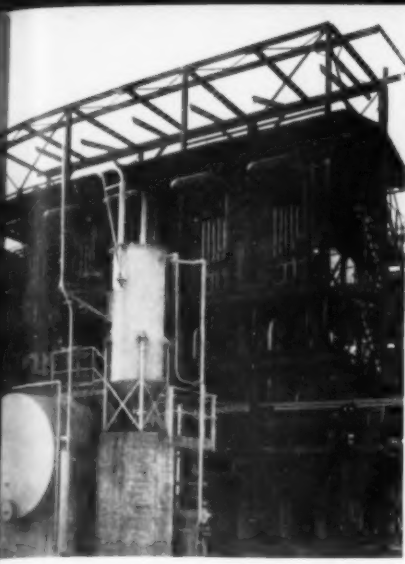
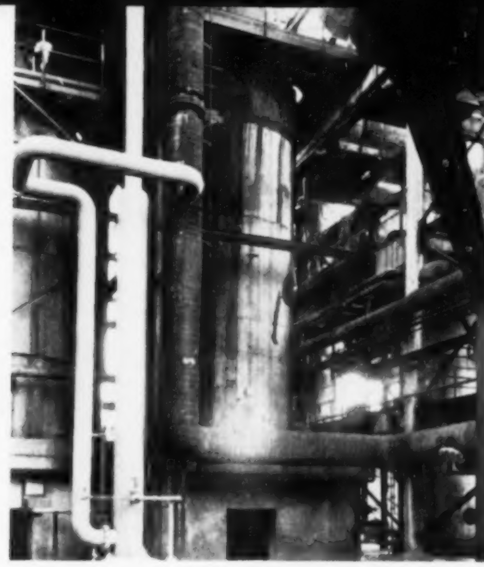
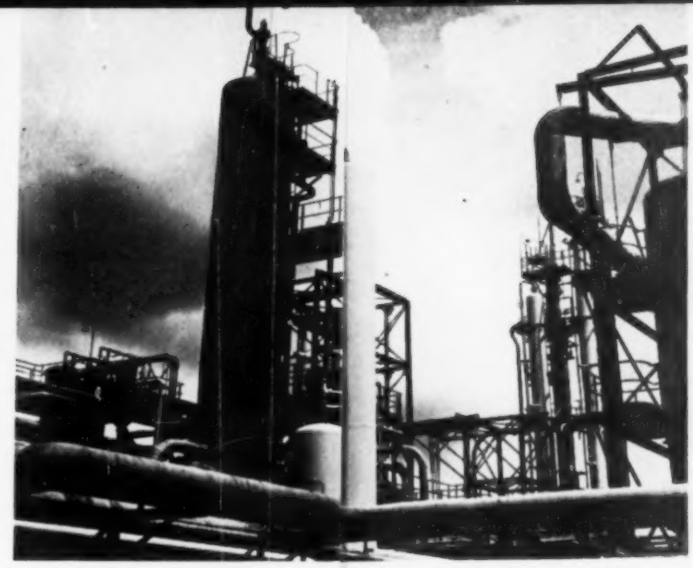
CHEMICAL & METALLURGICAL ENGINEERING
December, 1945
PAGES 134 TO 137



les, La. urified gas passes to reformer furnace.
from mate solution make-up in foreground

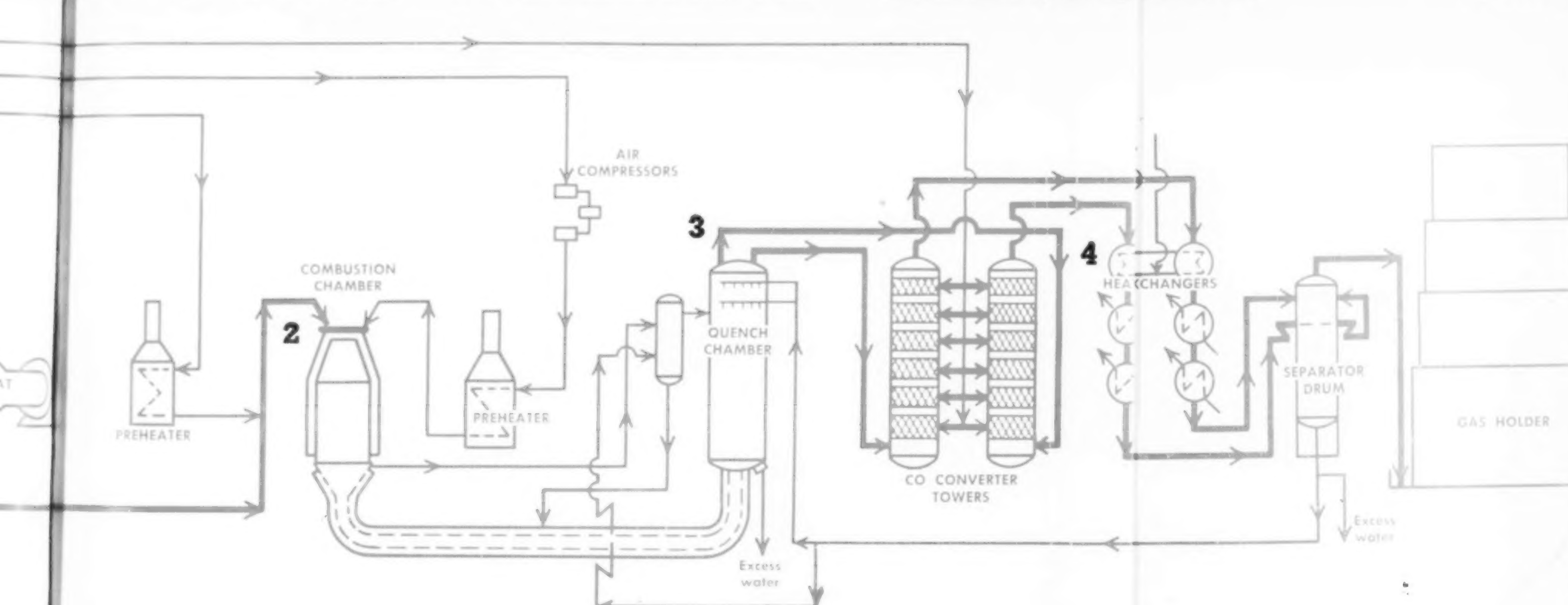


3 Temperature of gas is reduced to 800° F. in quench chamber by spray of water



5 Monoethanolamine entering of tower in Gerbitol system flows countercurrent to synthesis gaid absorbs CO_2

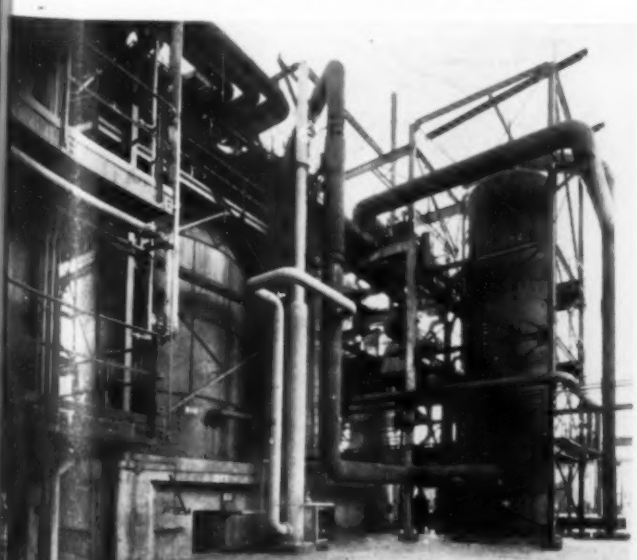
7 CO is absorb
cupric formate

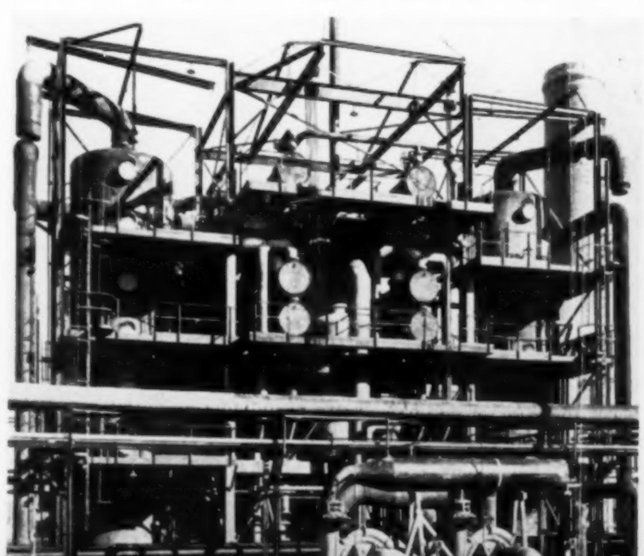


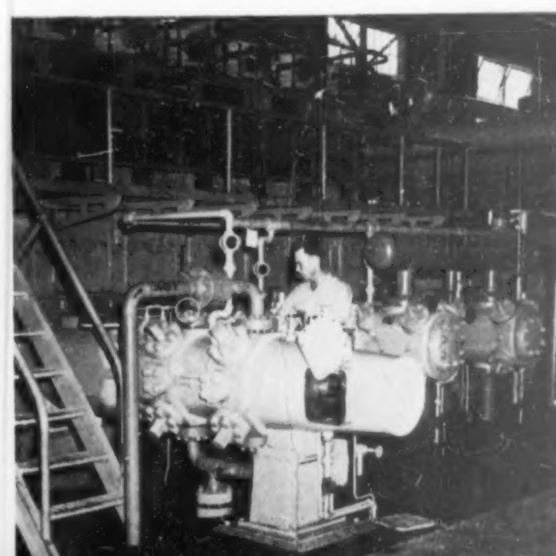
2 Undissociated methane and part of CO are consumed in combustion chamber at left. CO converter at right

4 Gas is passed through shift converters to change residual CO to CO_2. Hot gas enters tubular coolers in center

6 Through these primary compressors passes the
prior to conversion into ammonia



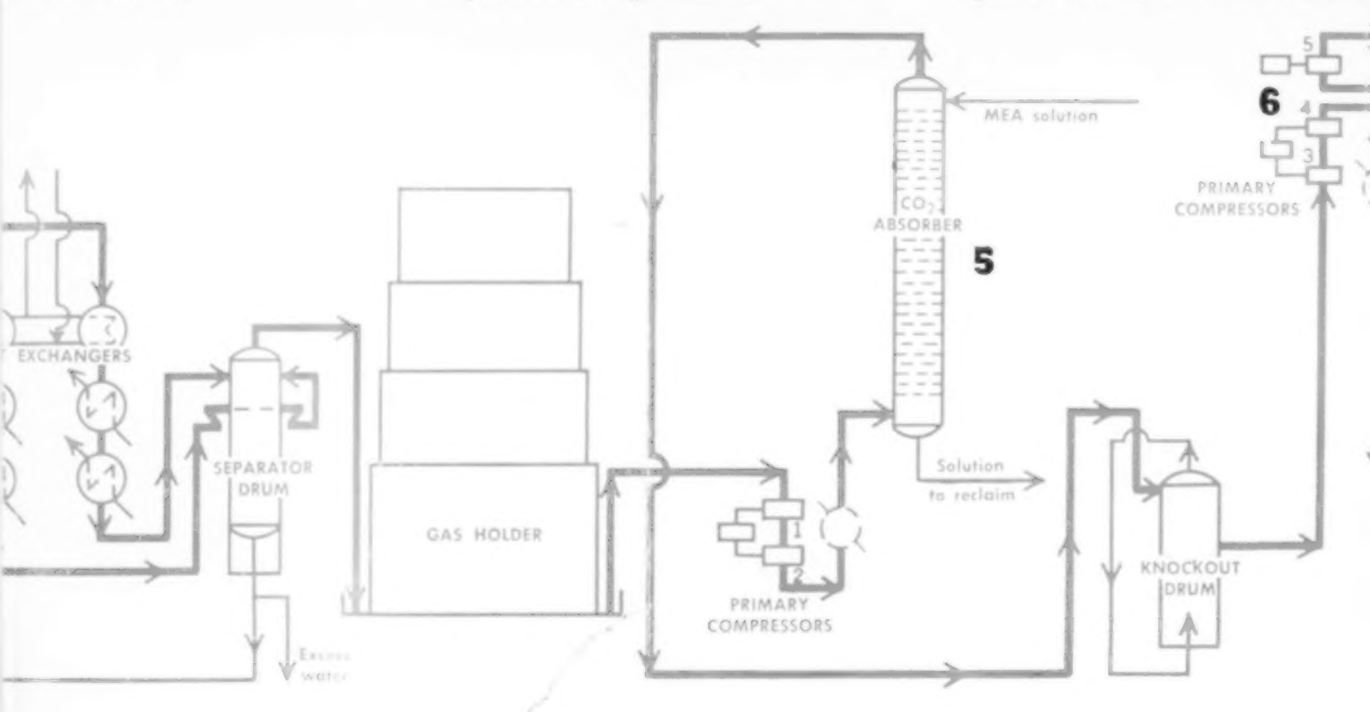




top of tower in Gerbitol system flows
and absorbs CO_2

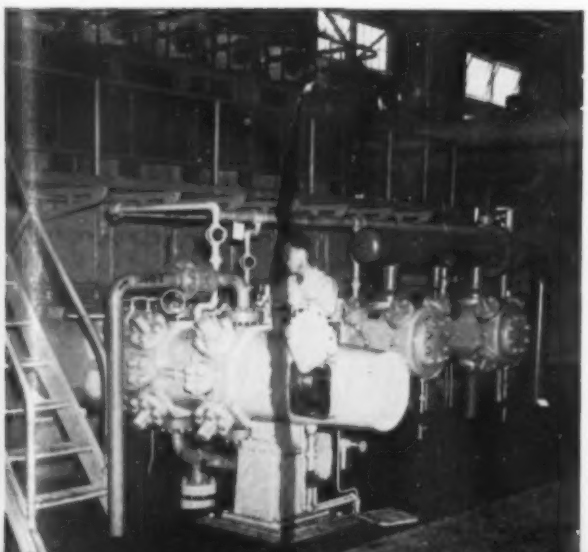
7 CO is absorbed in solution of cuprous and cupric formate in pressure vessel

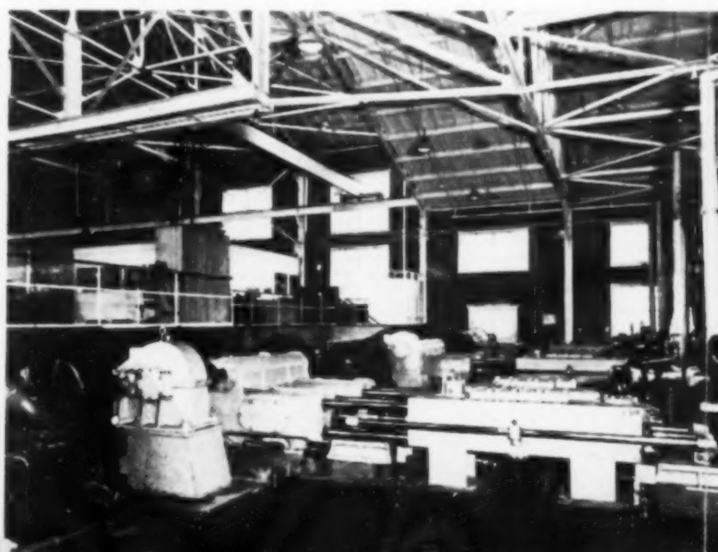
9 Gas passes to high pressure booster
pressors return gas to entrance of am

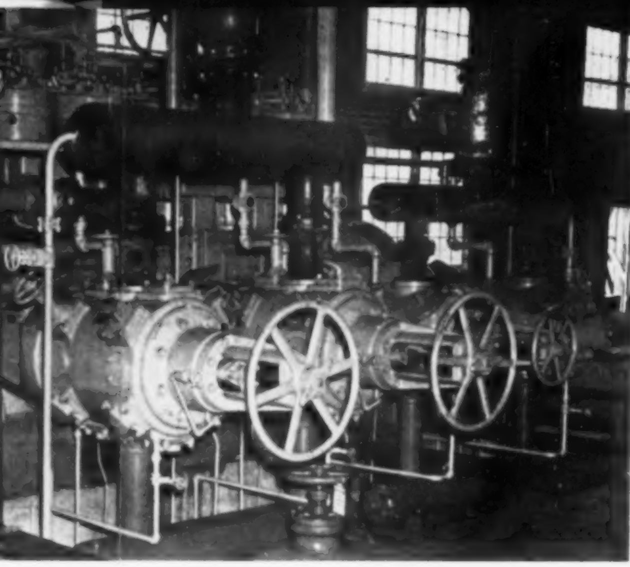


6 Through these primary compressors passes the gas prior to conversion into ammonia

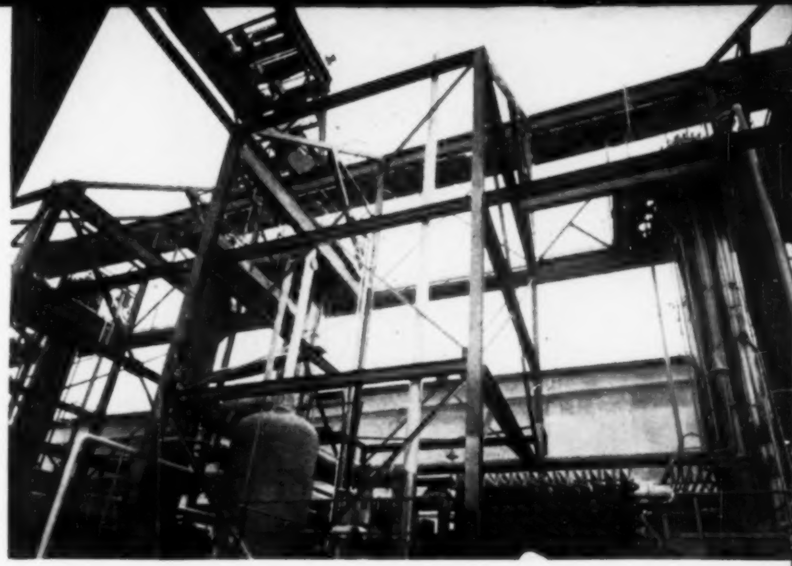
8 Cuprous and cupric formate solution is handled by pumps shown
CO forms unstable compound with formate and is absorbed



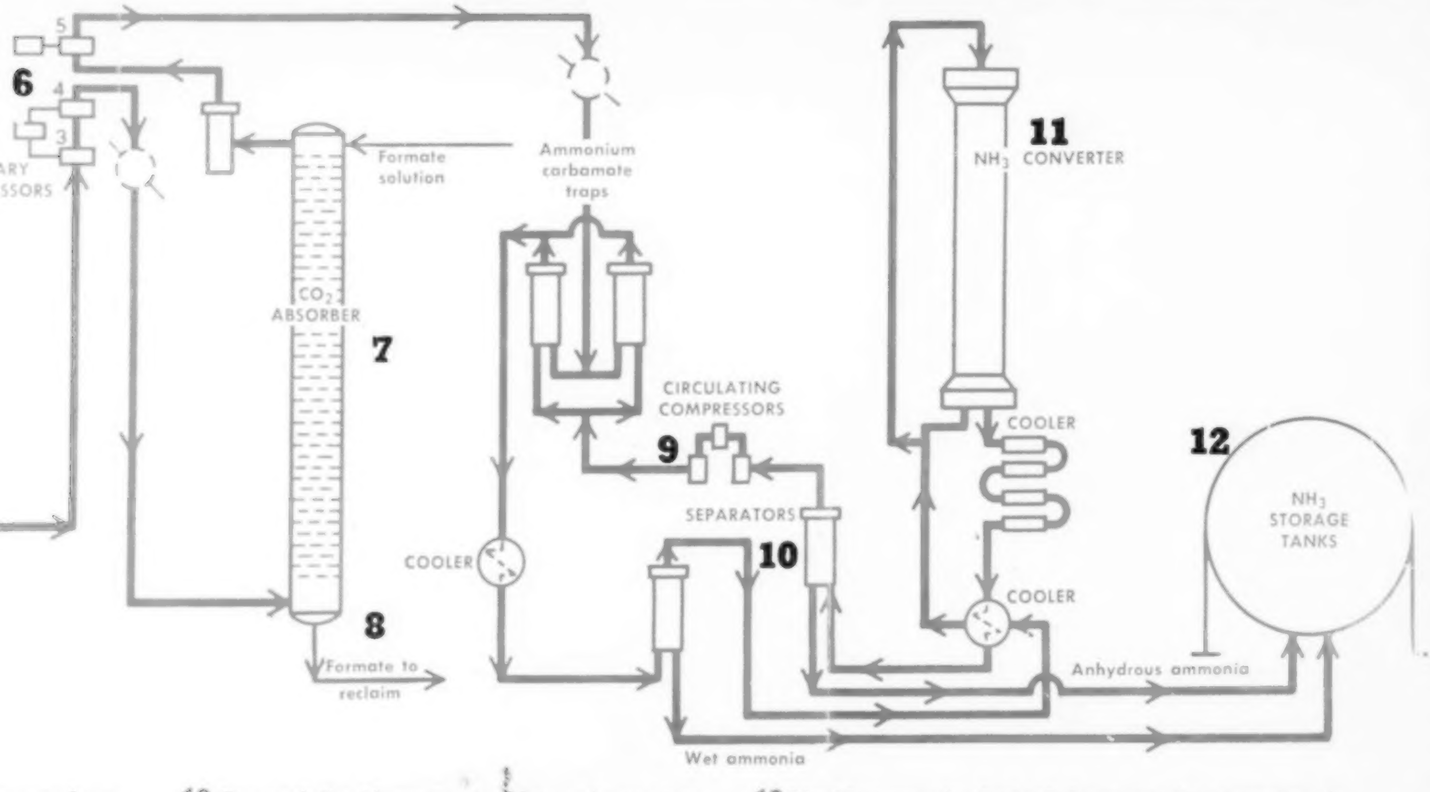




sure booster compressors known as circulators. These com-
rance of ammonium carbamate traps



11 In ammonia converters at extreme right and left reaction takes place at 952 deg. F. Gas leaving contains 16 percent ammonia



umps shown.
sorbed

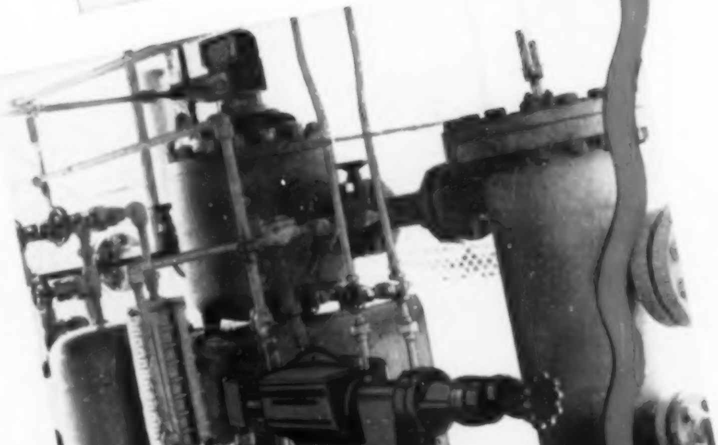
10 Gas and liquid ammonia enter primary separator in which latter collects and is drained off

12 Liquid ammonia drained from gas in separators is stored in insulated Hortonspheres

SAVE BY

"Composite Checking"

OF YOUR FLUID RAW MATERIALS WITH %PROPORTIONEERS% AUTOMATIC SAMPLING



CONTINUOUS PROPORTIONAL SAMPLING AT THE NECHES BUTANE PRODUCTS CO.

Automatic Sampling protects the purchaser of bulk shipments and assures him that the product received is up to specification standards. Diluence and foreign solvents are immediately detected by means of a single composite sample which may be readily varied in size from one barrel a day to five gallons a week. Equipment is fully flow responsive and meters main flow accurately. Several hundred %Proportioneers% sampling machines are now in use checking shipments of solvents, gasolines, food products oils, process chemicals, effluents, etc.

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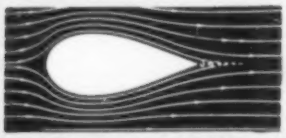
All Along the Line . . .
OVER YEARS OF SERVICE



THIS FLOW PATTERN MEANS NO TURBULENCE
The Streamlined form of the inner valve produces the flow pattern shown above which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

"Cheap in cost in the long run" is the way they describe this CASH STANDARD "1000"—the valve with the straight line flow that gives you close delivery pressure control—accurate regulation, and greater capacity. You save money all along the line over years of service because of smooth operation and continuous performance. You have no production stoppages or product spoilage due to valve inefficiencies and there's practically no maintenance required. "Put the '1000' on the line and forget it" is another general expression of users. Investigate now and see why you can cut valve cost expenditures and at the same time get "tops" in performance.

Bulletin 962

features the CASH STANDARD Streamlined Type 1000 Pressure Reducing Valve—illustrates the streamlined construction and tells why you get exceptionally long, trouble-free, low-cost performance. Points out why you get no turbulence and therefore can meet peak demand at all times. Explains why straightline flow gives you maximum capacity, close delivery pressure control, and tight closure.

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABL
ON OTHER
CASH STANDARD
VALVES
Send for them

BULLETIN 966—features the CAS STANDARD Self-Contained, Pilot Oper ated Type 10 Pressure Reducing an Regulating Valve for use with water air, with any gas or oil that is no corrosive, and with refrigerating flu such as Ammonia and Freon. Many in teresting particulars explained such a how valve works, tight seating, larg capacity, no waste, no water hamm or chatter.

BULLETIN 956—features the CAS STANDARD Type 4030 Back Pressur Valve—designed to automatically main tain a constant pressure in the evapora tor corresponding to a constant tem perature desired. Shows an Ammon and Freon Gas Capacity Chart base on ABSOLUTE pressures.

BULLETIN 969—features the CAS STANDARD Series 35 Constant Pressur Pump Governors—direct-operated an pilot-operated which automatically con trol steam-driven pumps to maintain a constant pump discharge pressure or constant vacuum on vacuum pump Tells about their use with reciprocatin pumps, turbine-driven pumps and com pressors, including compressors for re frigeration use. Has two pages of typical installations.

NEW PRODUCTS AND MATERIALS

R. W. PORTER, Assistant Editor

POUR POINT DEPRESSANT

Pour-point depressants, materials which, added to the oils, serve to lower the point at which solidification takes place, have not given complete satisfaction under conditions where the temperature fluctuates between the natural and the depressant pour points. A new depressant, Acryloid 150, however, is said not only to lower the pour point of many oils effectively, but retains the reduced pour point under cyclic temperature changes. Stable pour points as much as 40 to 50 deg. F. below the original pour point are readily obtained by using this new material developed by the Rohn & Haas Co., Philadelphia, Pa. Paraffin-base motor oils in the SAE-10 and SAE-20 range which show a pronounced tendency to revert to their original pour points with some additives are said to be effectively stabilized with Acryloid 150, which also acts as a viscosity index improver. These qualities make it possible to raise the viscosity index appreciably and at the same time effectively lower the pour point with the addition of this one material.

Used in quantities of about one percent, this material has been extensively evaluated in various tests including the standard 36-hr. Chevrolet oxidation and bearing corrosion test. It is readily blended with mineral oils by any of the common methods, but since Acryloid 150 is a fairly viscous product, it is desirable either to heat it to about 150 deg. F. before adding, or to heat the entire blend after the addition of the depressant. Cost of treatment is said to be low, particularly when the value of the improvement in viscosity index and the increased yield resulting from the lowering of the waxing requirements is considered.

RESORCINOL ADHESIVES

Reconversion to peacetime manufacturing, together with greater supplies of raw materials, has made it possible for the Casein Co. of America, Div. of the Borden Co., New York, N. Y., to make available, Cascophen an adhesive developed in 1943 for use in the construction of wood gliders, boats, rafts, etc. This new resorcinol resin glue is a dark, wine-colored liquid and is supplied with a separate powdered catalyst. Having many of the properties of a molding resin and possessing high strength even in thick film, Cascophen is adaptable for use on sawed surfaces or on joints which may not be perfectly fitted. It requires only sufficient pressure to insure good penetration into the surface. One of the outstanding features of this new adhesive is its ability to develop a boil-proof, completely durable phenol resin type bond at room temperature. Although

CONTENTS

developed primarily for gluing wood, the product is said to be effective in bonding practically any material with some degree of porosity. Such materials include cloth, paper, cork, leather, linoleum, vulcanized fiber, crockery, glass fiber, asbestos boards and plastics.

VARNISH RESINS

Formulated to make possible a higher viscosity varnish while still retaining exceptionally fast drying time and other desirable properties, Durez 220V, a new modified phenolic oil soluble resin, has recently been announced by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. In contrast to most modified phenolic resins, Durez 220V resin is claimed to produce a higher viscosity varnish in a shorter cooking period, and at the same time retaining its fast drying characteristics. It cooks to a brilliant, very pale, clear varnish, or may be used entirely as a "chill back." Even extremely short cooks, will not result in clouding from fast addition of thinner.

Durez 220V is said to have excellent water and chemical resistance, as well as durability and color retention. It is claimed that with this material kauri reduction values of 25 to 30 percent are obtained in short to medium length varnishes. The resin will cold cut in mineral spirits and may also be used in a gloss oil.

OIL SOLUBLE DDT

With the manufacture of an oil soluble DDT concentrate, the Hercules Powder Co., Wilmington, Del., has rounded out its line to make available seven different types of effective toxicants suitable for the formulation of all kinds of sprays and dust for household, livestock, farm, kennel, extermination, industrial or public health work. This new oil soluble DDT concentrate contains 25 percent DDT in a new solvent mixture and is designed for the economical formulation of residual type DDT sprays. It is available only to insecticide manufacturers and may be used either alone or in combination with small proportions of other toxicants which contribute quick knockdown and kill characteristics.

The other six toxicants manufactured by Hercules are Aerosol DDT, Thanite, Thanite plus DDT concentrate, Thanisol 70, Thanisol 70 plus DDT concentrate, and water-miscible DDT concentrate.

EMULSION CLEANER

In announcing their new emulsion type cleaner, PSC, for use in power spray washers, the Phillips Chemical Co., Chicago, Ill., claims that all metal parts may be inhibited against rusting, corroding and hand-soil long enough for inspection or storage up to several weeks. PSC cleans ferrous and non-ferrous metals, is non-toxic, non-injurious to the skin and requires no rinsing. It is necessary only to wash the parts and blow them dry with air for complete cleaning and rust inhibition. This cleaning compound removes grease, oil, wax, lapping and drawing compounds of all kinds, red lead and other markings, abrasive dust, and other foreign material. Its cleaning action results from its penetrating properties in which it penetrates to the surface of the metal, breaking organic dirt into tiny particles which rise to the top of the solution in the tank while the heavy solid particles sink to the bottom. The blanket of dirt at the top may be periodically overflowed, keeping the bulk of the solution in the tank clean. This cleaning compound is available in three types: No. 1 for light duty, No. 2 for heavy duty, and No. 3 for special rust

CORROSION-PROOF COATING

Recently developed by Baker Synthetics, Inc., New York, N. Y., a new impermeable air-drying film under the brand name of Corrosite is said to be resistant to acids, alkalis, and many chemicals. Consisting of a mixture of several resins, plus an adhesive, this new coating is essentially a combination thermoplastic and thermosetting film which should prove valuable in chemical plants wherever acid

and alkalis are used. Important qualities of Corrosite are (1) that it will bond to practically any clean surface, including old paint; (2) it offers better abrasion resistance than can be achieved with most other materials without the use of heat; (3) it is electrolytically impervious to the extent that a three-coat application will completely eliminate deterioration caused by electrolytic corrosion.

Applied exactly like paint, Corrosite will not crack, chip or lift, and will withstand temperatures up to 250 deg. F. No prime or intermediate coats are required, and no special or unusual surface preparation is needed. Successive coats can be applied with only one hour's drying time between them, permitting a three-coat application in a single day. The finished film is said to have a smoothness comparable to porcelain. Corrosite weighs 9 lb. per gal., and has a coverage up to 450 sq.ft. per gal. It is available in black, clear, aluminum and gray, and is shipped in 5-gal. cans and 55-gal. drums.

RAT POISON

Discovered by a psychiatrist at Johns Hopkins Hospital, Baltimore, ANTU is a gray powder so poisonous that a pinch will kill thousands of Norway rats commonly found in northern cities. Consisting of alpha-napthyl thiouera, ANTU causes dropsy of the lungs which drowns the rat in its own body fluids. It is safe to use and does not kill humans or dogs, and is easily dusted on bait or runways. Its main use will be found in northern climates since it is not effective against the black rats most commonly found in warmer climates. This poison is manufactured by E. I. du Pont de Nemours & Co., Wilmington, Del.

DISPERSING AGENT

Developed by the Beacon Co., Boston, Mass., a new family of dispersing agents designated as the Betanols consist of high molecular weight esters expressly made to form dispersions which are stable in the presence of acids and mineral salts, and over a wide pH range. They possess water absorption power, and their water dispersions or solutions have a fairly high viscosity. Both water and oil, and oil and water emulsions can be made with these agents. The Betanols may find use in the cosmetic , pharmaceutical, textile and paint industries, and are suggested wherever a dispersing agent or wetting agent is needed which is to be used in the presence of acids, bases, or mineral salts. A summary of the properties and the behavior of the various Betanols in different solvents and solutions is shown in the accompanying table.

BUTYL CROTONATE

Now available in pilot plant quantities from 1-lb. bottles to 400-lb. steel drums, butyl crotonate is now being manufactured by the Shawinigan Products Corp., Empire State Bldg., New York, N. Y. This material is a colorless liquid with a pleasant persistent odor. It is soluble in alcohol and ether, but only slightly soluble in water. It has the following properties and specifications:

Physical Constants and Properties

Molecular weight	142.2
Color	Water White
Freezing point, deg. C	−37 to −39
Boiling point, deg. C	176.4 (Corr.)
Specific gravity, 20/20°C	0.9037
20/4°C	0.903
Refractive index, n 24 deg./D	1.4277

Specifications (Tech. Grade)

Butyl crotonate, percent	98 to 99
Acidity (as crotonic), percent max.	0.5
Boiling range, deg. C	175 to 182
Water	None
Color	Water White
Chlorides, iron, sulphates	None
Specific gravity, 20 deg. C	0.901-0.903

PERMANENT WICK

Made of asbestos yarn, a cigarette lighter wick that practically never requires trimming or replacement has been recently developed by the United States Rubber Co. Formerly wicks were twisted instead of braided and had a tendency to unravel, producing a flickering, smoky flame. The new wick, however, is tightly braided to prevent fraying and "blossoming," which frequently puts lighters out of operation, and is built around a small core of glass yarn which provides improved capillary action for proper feeding of fluids.

SURGICAL SPONGE

Now released for civilian consumption, a new surgical sponge derived from human blood is available from the Cutter Laboratories, Berkeley, Calif. Fibrin Foam and Thrombin (human) contains the normal protein constituents which are responsible for the formation of blood clots and has been found valuable in brain, liver, kidney and spleen surgery for the past several years. This surgical sponge, used in delicate operations, is left in the surgical wound where the fibrin foam is then gradually absorbed by the system of the patient.

Fibrin Foam and Thrombin (human) is packaged in three-bottle sets; one containing Fibrin foam, one Thrombin (which acts as a coagulating agent) and the diluent for the Thrombin. The technique employed in using this product is to dilute the thrombin with the diluent (salt solution), pour the diluted thrombin over the fibrin foam, and place the soaked sponge on the bleeding area. The thrombin will cause the blood to clot, the foam will provide surface for the clotting to take place. In addition to its surgical uses, it is expected that this material will be useful in dental surgery where it is required to stop persistent bleeding in tooth sockets.

DETERGENT

Marketed under the brand name of K.P., a new soapless cleaner is now available from the K.P. Chemical Co., New York, N. Y. Used extensively during the war, this detergent material has been used to clean castings and grease-coated machinery in a manner said to be more effective than acid. The cleaning action of this material is said to have been satisfactorily tested in aviation, machine tool and automotive applications, with good results. K.P. contains no abrasives, and is entirely soluble, and is prepared in powdered form. It is packed in 50-lb. cartons and 350-lb. drums, and will be distributed through jobbers, supply houses and sales representatives.

PLASTIC SEALS

Developed for the purpose of making seals that are air and water-tight, a new plastic compound has been used to seal the ends of metal tubing. Manufactured by the Plastics Div. of the General Electric Co., Pittsfield, Mass., this new material is now being used as lead markers on wires and cables. Consisting of caps and sleeves, they are available in colors

Plastic sealing caps

Properties of Betanols

Betanol—	107	114	132	401	520	540	560	564	701
Form	sol.	sol.	sol.	sol.	liq.	liq.	liq.	liq.	sol.
Color	wht.	wht.	tan	l. tan	l. straw	amb.	amb.	amb.	tan
Melting Pt.	40-52°C	52-53	52-54	43-45	.....	.....	.....	.....	54-56
Behavior of 100g. of Betanol in 100 c.c. of the Solvent or Solution:									
Water	DH	DH	SH	DH	DC	DC	DC	SC	SH
Alcohol	SH	SH	SC	SH	SH	SH	PSC	SC	SC
Aldehydes	SH	SH	SC	SH	SH	SH	SC	SC	SC
Ketones	SH	SH	SC	SH	SH	SH	SC	SC	SC
Pet solvent	PSH	PSH	I	SC	PSC	PSC	I	I	PSH
Mineral oil	PSH	PSH	SISH	SC	SH	SC	PSC	PSC	PSH
Vegetable oil	SH	SH	SH	SH	SC	SC	SC	SC	SH
Glycerine	SH	SH	SH	SH	SC	SC	SC	SC	SH
Fatty acids	SH	SH	SH	SH	SC	SC	SC	SC	SH
Glycol	SH	SH	SH	SH	SC	SC	SC	SC	SH
10% HCl	DH	DH	SH	DH	DC	SC	DC	SC	SH
10% H_2SO_4	DH	DH	SH	DH	DC	SC	DC	SC	SH
10% HNO_3	DH	DH	SH	DH	DC	SC	DC	SC	SH
10% $CaCl_2$	DH	DH	SH	DH	DC	DC	I	DC	SH
10% $Al_2(SO_4)_3$	DH	DH	DH	DH	I	I	I	I	DH
Aromatic hydrocarbons	SC	SH	SH	SC	SH	SH	S	S	S

Legend: PD—partially dispersible, SC—soluble cold, SH—soluble hot, DC—dispersible cold, DH—dispersible hot, PSH—partially soluble hot, PSC—partially soluble cold, SISC—slightly soluble cold, SISH—slightly soluble hot, I—insoluble.

red, blue, green, orange, yellow, white and transparent, and their excellent electrical properties make them useful as an insulation covering for bus bars, selsyn motors, and wire cleats. Previous to use, these caps and sleeves must be soaked in GE dilater solution which expands them as much as 50 percent of their normal size. They are then placed in position and allowed to dry. When thoroughly dry, they shrink to smaller than their normal size to form a tight fit and can be trimmed to any length with a trademark added if desirable.

PLASTICIZERS

SEVERAL new plasticizers for vinyl resins, synthetic rubber, and other products used in protective coatings and plastics have been announced by the Amecco Chemicals, Inc., Rochester, N. Y. These are described as follows:

Plasticizer 7-2 has high plasticizing power, low-volatility at elevated temperatures and low temperature flexibility. It is a light straw colored liquid weighing 9.1 lb. per gal., and has a specific gravity of 1.09 at 25 deg. C. Plasticizer 11-2 has good low-temperature flexibility and low volatility at elevated temperatures. It is a light straw colored liquid weighing 10.0 lb. per gal. with a specific gravity of 1.20 at 25 deg. C. Plasticizer 8 has a tendency to decompose when heated for long periods of time at high temperatures and is suitable in coatings which are spread on from solvents or emulsion rather than in calendered goods. It is a straw colored liquid with a specific gravity of 1.20 at 25 deg. C., weighing 10.0 lb. per gal.

Paroil 177-K is inexpensive and can be used in high proportions. However, it decomposes and darkens when heated for long periods of time at elevated temperatures and is not recommended for use in calendered goods where light color and clear film is important. When suitably compounded with pigments Paroil 177-K can be used in white and colored calendered goods. It is an amber-colored liquid with a specific gravity of 1.64 at 25 deg. C., weighing 13.7 lb. per gal. All of these plasticizers are comparable to dibutyl and dioctyl phthalate and tricresyl phosphates.

COATING RESINS

FIRST of a new series of styrene resins produced by the Dow Chemical Co., Midland, Mich., resin 276-V2 and 276-V9 were developed for use in metal, wood, fabric and paper coatings and with plastics and wax compositions. These new plasticizing resins are described as water white, non-yellowing, viscous liquids which are chemically inert and which possess an attractive combination of properties; they are soluble in all common organic solvents except the lower alcohols, and are compatible with a wide variety of film formers and plasticizers. Wide application of these new resins is expected to result from their workability with waxes and their resistance to alkalis. 276-V resins are also claimed to be compatible with both ester and oil type plasticizers, including phthalate esters, tricresyl phosphate and castor oil.

276-V9 is compatible with the following waxes at ratios of 3:1, 1:1, and 1:3 parts of resin to wax, chinese insect wax, japan wax, montan wax, spermaceti, paraffin wax, opal wax, Carbowax 4000, Carbowax 6000 and Acrawax. These mixtures form clear transparent single-phase melts when hot and set to smooth, homogeneous pastes upon cooling. The accompanying tables show the properties and compatibility with film formers, resins and plasticizers.

These resins have good electrical properties, ready solubility, alcohol and chemical resistance, lack of acidity and stability and aging, which makes them useful in plastic and calendering compositions, bronzing lacquers, paper lacquers, flexible coatings, pressure sensitive adhesives, emulsion, rubber compounds and lacquers. They are avaliable in 5, 10 and 55-gal. drums.

Typical Properties of 276-V Resins

	276-V9	276-V2
Boiling range (5% to 95%) at 5mm. Hg, deg. C.	150-300	150-300
Specific gravity at 60/60 deg. C.	1.04	1.01
Lb. per gal. at 25 deg. C.	8.66	8.40
Viscosity at 60 deg. C., centipoises	700–1000	100–200
Flash point, approximately, deg. F.	360	330
Fire point, approximately, deg. F.	405	360
Volatility,[1] 100 hr. at 100 deg. C., percent	1.5–2.0	2.5–3.0
Refractive index at 60 deg. C	1.57	1.58
Color[2] (iodine standard)	0.3	0.4
Acid number, less than	0.1	0.1
Iodine number, less than	4.0	4.0
Dielectric constant at 1 megacycle	2.74	2.74
Power factor at 1 megacycle, percent	0.017	0.017

[1] Loss in weight of approximately 150 g. material contained in 250 ml. flat bottomed flask. [2] Iodine method as described in the "Handbook of Petroleum, Asphalt and Natural Gas" by Cross.

Compatability of 276-V9 With Typical Film Formers

Film Former	Percent of 276-V9 in Film to Give SI. Haze	Decreased Gloss
Nitrocellulose	15	45
Cellulose acetate	5	35
Cellulose acetate butyrate	65	85
Cellulose acetate propionate	50	65
Ethocel 49E type	60	80
Ethocel 46E type	40	45
Polystyrene	Infinitely Compatible	
Vinylite VYHH	15	75
Vinylite AYAA	10	75
Vinyl butyral	40	75

Compatability of 276-V9 With Various Resins

Resin	At Ratio of 276-V9 Resin 3:1	1:1	1:3
W. W. Rosin	C	C	C
Staybelite (hydrogenated rosin)	C	C	C
Ester gum	C	C	C
Polypale resin (polymerized rosin)	C	C	C
Bakelite BR 254 (pure phenolic)	C	C	H
Superbeckacite 1001 (pure phenolic)	C	C	C
Amberol F-7 (modified phenolic)	C	C	C
Beckosol 24 (plasticizing alkyd)	H	C	C
Rezyl 775-1 (alkyd)	C	C	C
Amberol 800-L (maleic)	C	C	H
Uformite MU56 (melamine formaldehyde)	H	C	C

C = clear, compatible mixture; H = hazy mixture.

ACID-RESISTANT SHIRTS

SPECIAL acid-resistant shirts woven of Vinyon synthetic resin yarn are now being worn by employees of the American Viscose Corp. In the past, employees working near rayon spinning baths, which contain sulphuric acid, sodium sulphate and zinc sulphate, found that ordinary shirts deteriorated rapidly. Because of this, experiments were carried on which resulted in shirts made of a loosely woven porous net fabric which are light and cool and which are acid-resistant. Reports on these shirts indicate that they have given good service and were not harmed by constant exposure to these chemicals. They are not intended as protection against chemical contact, but merely as a practical work garment which has a very low moisture absorption rate, washes easily, and has a long service life.

TACKIFIER

QUITE widely publicized as one of the more important chemical compounds used by the Germans in fabricating synthetic rubber, Koresin is now being produced on a pilot plant scale by the General Aniline & Film Corp., New York. Koresin is a synthetic resin, a tertiary butyl phenol acetylene condensation product, which imparts to synthetic rubber a tackiness which aids in the fabrication of tires. Plans are being made to meet the full commercial demand for this substance and various manufacturers are now experimenting with this product, which has possible uses in many industries.

HIGH TEMPERATURE CERAMICS

DESIGNATED as M-244, a new ceramic material developed by the General Ceramics & Steatite Corp., Keasbey, N. J., is said to have a high thermal expansion coefficient and high resistance to extreme thermal shock. After being heated to a temperature of 1,400 deg. F. and then immediately plunged into an ice water bath, this material did not crack and retained its original dimensions at both temperature extremes within the same limits characteristic of nickel-steel alloys.

Potential uses for this new material are in high temperature furnaces, insulation for high precision instruments in which dimensional changes must be absolutely minimized, and for many electrical and electronic purposes demanding a low thermal expansion coefficient in high quality ceramic parts. The manufacturer plans to supply this ceramic material in various shapes which can be formed by pressing, extruding or casting. Some of the properties of M-244 are included in the accompanying table:

Coefficient of thermal expansion:	Up to 600 deg. F.	1.6 × 10[illegible]
	Up to 1,000 deg. F.	1.9 × 10[illegible]
Modulus of rupture:	5-in. span	9.2[illegible]
	2-in. span	11.[illegible]
Dielectric constant (1,000Kc)		5.3[illegible]
Power factor, percent		0.5[illegible]
Dielectric strength, v. per mil		90

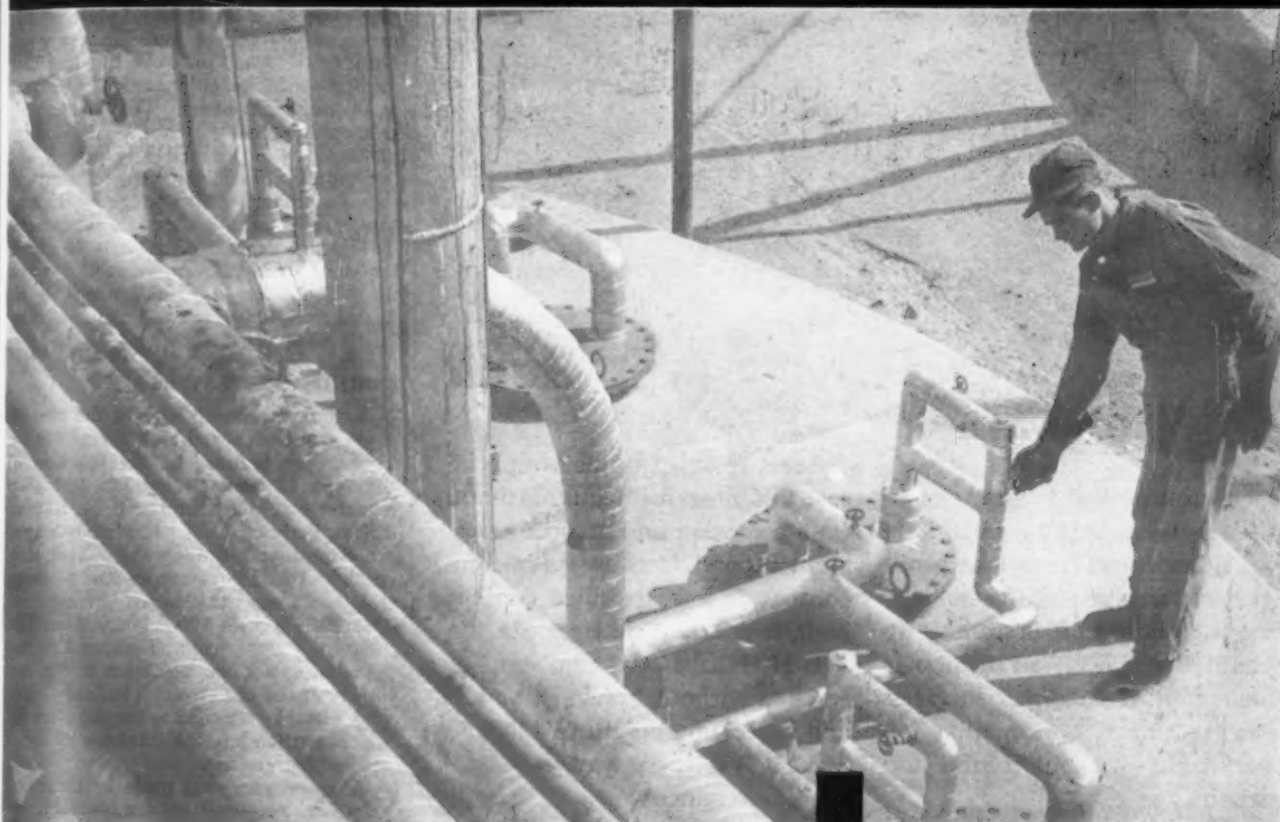
Material withstands a temperature of 2,500 deg. F.

LOW-CARBON FERROMANGANESE

NOW AVAILABLE at the same price as the regular grade, a new special low-carbon ferromanganese has been announced by Electro Metallurgical Sales Corp., New York, N. Y. This material is now produced in the maximum 0.10 percent carbon grades and has the following typical analysis: Manganese, 90.00 percent minimum; phosphorus, 0.06 percent; carbon, 0.06 percent. This high purity manganese is particularly useful in stainless and other high quality alloy steels.

PROTECTIVE COATING

PROTECTION of floors and equipment from fumes and spillage, as well as corrosion from acids and alkalis can be obtained by use of a plasticized resin protec-



tive coating made by the Wilbur & Williams Co., Boston, Mass. Designated as Acid-Causticbond this material has been thoroughly tested against strong caustics and corrosive acids and is now available in several colors, including light gray and ivory tan. It is brush-applied for air drying and may be used for tank interiors and other submerged surfaces.

INSECTICIDE CARRIER

Supplys of diluents such as talc and pyrophylite have been limited during the war. The Engineering and Industrial Experiment Station of the University of Florida has carried on work to show that finely ground Florida limerock can be used as an insecticide carrier. Tests made with this new dust have shown that it is completely inert toward DDT which is not decomposed by the limerock even when they are heated together in the presence of water vapor at 100 deg. C. for several days. Large deposits of this soft variety of limestone in Florida are available for this use. The finely ground limerock is air floated to eliminate grit and coarse particles from finished products.

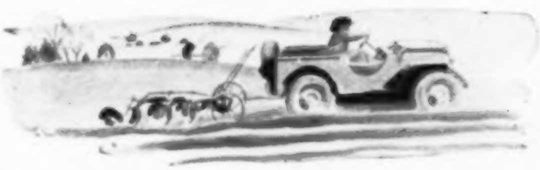
CORROSION TEST STRIP

Accurate measurements of the existent corrosivity of new and used engine oils for lead copper bearings, is the function of the type C bearing corrosion test strip manufactured and distributed by Randall & Sons, Berkeley, Calif. The test is simple, economical and time saving. The strip consists of lead on a copper base in seven steps of different thicknesses ranging from 3/1,000,000 in. to 100/1,000,000 in. The number of steps removed within the test period gives a visual indication of the corrosivity of the engine oil. The lead copper strip is usually attached to the dip strip for direct insertion into the crankcase of diesel and gasoline engines.

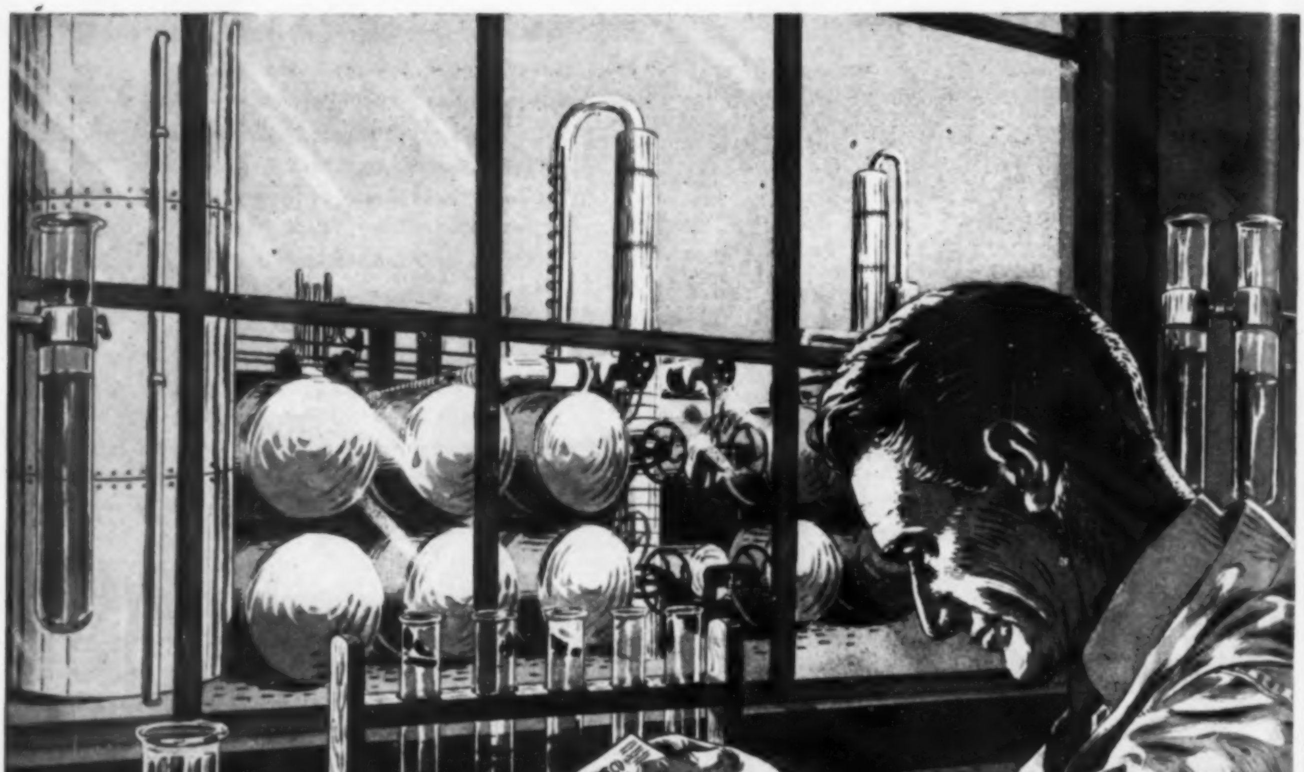
Since measurements made by these test strips are by means of a process of corrosion they are believed to give more reliable indication of corrosion than can be obtained by any indirect measurement such as neutralization number. They find their greatest usefulness in following the development of corrosivity in oils and thus indicate whether corrosion may be involved in engine operation. In addition they provide a means for comparing the effects of acid upon the development of corrosivity in oils during use and afford a simple and rapid laboratory method for testing oils drained from the engines.

FUNGICIDE

Ferric diethyldithiocarbamate is the basic material of a new organic fungicide manufactured by E. I. du Pont de Nemours & Co., Wilmington, Del. Known as Fermate, it is compatible with summer oils, oil-nicotine or oil-lead arsenate combinations. It is highly effective against many fungi and is safely used on a wide variety of plants. It does not cause severe chemical russeting on pears and apples, such as frequently results from the use of some of the other fungicides on the market. Fermate is a fluffy black powder of very small particle size and it is relatively hard to wet, which is one reason why it adheres well to foliage and fruits.




ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT



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CHEMICAL ENGINEERING NEWS

SCIENCE APPLIED IN INDUSTRY IS THEME OF 20th EXPOSITION OF CHEMICAL INDUSTRIES

PLANS FOR the 20th Exposition of Chemical Industries to be held in Grand Central Palace, New York City, February 25-March 2, are progressing at a rate which indicates that all space for exhibition purposes will be filled. For the most part exhibits will reflect the influence of wartime technology on progressive manufacturers.

Grand Central Palace already is booked full up to three floors and a substantial portion of the fourth. A majority of exhibitors are manufacturers of industrial chemicals and chemical processing machinery and equipment, representing leadership in this field, but there will also be numerous recent recruits and the list of "firsts" among the products displayed is expected to be both long and promising.

An important feature of the forthcoming exposition will be the freedom from restraints prevailing during the past four years.

The last Chemical Exposition in the Palace closed on the eve of Pearl Harbor and from then until now critical materials have been scarce, rationed or not available and the operation of many plants obscured or secret. Now many familiar materials are flowing again through accustomed channels, a great many new ones are available and new applications are developing through their utilization in improved design.

Copper may now be had for civilian purposes, which to the chemical industries means supplies for the manufacture of kettles, mixers, heat exchangers, coolers, storage heaters, piping and tubing and many other equipment items. The list of items requiring metals with which copper is alloyed is even longer.

Stainless steel also is available once more. Now it is offered as one of the most versatile materials in industrial manufacture, but when first introduced at the Chemical Exposition its obvious advantages were offset by the fact that for many purposes it was almost unworkable. Advances in composition and treatment and special methods of fabrication have overcome many such difficulties, especially in the recent past, and it is finding new applications in many of the specialties to be exhibited.

Magnesium is another recently rare metal, now making its mark in structural uses combining strength with light weight. But while the non-ferrous metals are entering into many advanced designs of machinery and processing equipment, knowledge of steel has benefited from the stringencies of the war period. Out of the long list of national emergency compositions have come at least five numbers which are now regarded as standards for production purposes, while an even greater advance from the production standpoint is the relation of hardness to chemical composition. These and other forward steps in metallurgy facilitate improvement in mechanical structures and also challenge manufacturers of equipment to keep pace with progress.

Improvements in the metals and in other lesser known fields, refractories, glass, plastics and non-structural materials, have provided the means for many of the highly intensified procedures required in manufacturing some of the new substances of which chemical industries are now availing themselves. Where the electric arc once stood forth conspicuously as the source of high processing temperatures and the means of synthesizing new mineral substances, today high vacuums, temperatures and pressures are commonly used; refrigeration of metals in connection with manufacturing operations, electric induction heating, electronic evaporation and other innovations facilitate the advent of new substances. The exposition includes both processes and products that are new to commerce, many of them tested in war.

Exhibits will reflect noteworthy improvement in instruments and control systems, such as form the mechanical "brains" of chemical processing operations. One automatic phase timing control permits as many as 900 "on-off" operations to be regulated in any sequence. In a single deep fermentation process, used in the manufacture of penicillin, 14 electronic controls are employed.

Chemical ingredients and final products, represented in the exhibitors' list cover a wide range in industrial products and processing, as well as the fields of biochemistry, technical supplies for the laboratory and medicinals. Of technical interest will be many innovations under byproduct classifications, tendered for use in compounding and improving chemical products all along the line from edibles to insecticides and from coatings to catylizers.

At least one exhibitor specializes in the design and construction of complete processing plants, while another, tuning in with the times, has devised a special inventory system with reference to the needs of reconverting industrial plants.

At no time in the history of the country have science and technology been so completely organized, or so closely integrated with industrial operations as they were during the crucial period of our latest wars, according to Charles F. Roth, president of the International Exposition Co. and manager of the Exposition. Nor have these special bonds between science and industry been severed by the termination of the military emergency, but they are being converted into new alliances which look toward far more rapid progress in industrialization than we have witnessed in the past. One marked characteristic of previous expositions of the chemical industries has been their stimulation of new and larger commercial undertakings. Mr. Roth believes this record will be upheld during the forthcoming exposition because of the great amount of suggestive material that will be on view.

LARGE GRANTS AVAILABLE TO FINANCE RESEARCH

SCIENTISTS who helped in the development of a host of vital war materials will have a chance to return to college laboratories for scientific research and teaching as a result of $2,500,000 in grants offered to educational institutions by Research Corp. of New York, a non-profit organization devoted to advancing research and technology by use of revenue from inventions assigned to it by public-spirited inventors. Preference in making these grants will be given to smaller institutions and those of more limited financial resources for research.

The five-year program announced by Dr. Joseph W. Barker, acting president, who has returned to his duties with the corporation and with Columbia University, will result in 100 to 200 grants of $2,500 to $5,000 each year in order that talented young scientists engaged for the most part in war research will be able to undertake research of peacetime importance especially in chemistry, physics, mathematics and engineering.

ALLIED CHEMICAL & DYE CONTINUES FELLOWSHIPS

SEVERAL years ago Allied Chemical & Dye Corp. established a graduate fellowship plan and it recently announced this plan will be continued through the present academic year. The plan was initiated with a view toward encouraging graduate study in chemistry and chemical engineering. In order to stimulate graduate study and help the universities to re-establish their graduate activities, the stipend of the fellowships has been raised from $750 to $1,000 which is exclusive of tuition and laboratory fees. A total of 24 fellowships is offered in 20 universities and as heretofore, recipients of the awards and the type of research are selected by the individual universities.

UNION CARBIDE ELECTS NEW OFFICERS

AT A RECENT meeting, Union Carbide & Carbon Corp. made several changes in its organization through the election of eight new vice presidents and the selection of Morse G. Diel as secretary-treasurer of the parent company. Mr. Diel had been serving as secretary-treasurer of some of the subsidiaries. Dr. Joseph G. Davidson, president of Carbide & Carbon Chemicals Corp., was elected vice president in charge

of the chemicals division. Stanley B Kirk, president of Linde Air Products Corp., was made vice president of the industrial gases division. James W. McLaughlin, president of Bakelite Corp., was selected as vice president of the plastics division. H. Earle Thompson, vice president Carbon & Carbide Chemicals, was appointed vice president of the engineering department. William J. Priestley, president of Electro Metallurgical Co., was elected vice president of the alloys and metals division. John H. Rodger, president of Oxweld Railroad Service Co., was chosen vice president of the railroad division. Arthur V. Wilker, president of National Carbon Co., was named vice president of the carbon division and Robert J. Hoffmann, president of Carbide Research Laboratories, was elected vice president of industrial relations.

ASME PRESENTS AWARDS AT ANNUAL DINNER

The American Society of Mechanical Engineers, which held its annual meeting at the Hotel Pennsylvania, New York, on November 26-29, conferred its annual honors and awards at a dinner held at the Hotel Astor on the evening of November 27. More than 1,500 members and guests were in attendance with Alex D. Bailey, president of the Society presiding. Lieutenant-General Ira C. Eaker, deputy commander, Army Air Forces, was the principal speaker.

The ASME Medal, the Society's highest honor, was awarded Dr. William Frederick Durand, professor emeritus of mechanical engineering, Stanford University, in recognition of his work in forwarding the design and application of principles of jet propulsion and for his leadership of the division of engineering and industrial research, National Research Council.

The Holly Medal was given to Dr. Sanford Alexander Moss, General Electric engineer of Lynn, Mass., for his many contributions to the development and application of turbo-superchargers to internal combustion engines. The Worcester Reed Warner Medal went to Joseph M. Juran, professor of and chairman of the department of administrative engineering, New York University, for his contribution to the problem of quality control in mass production. William Julian King of the fuels division, Battelle Memorial Institute, was presented with the Melville Prize Medal for an original work, for his paper "The Unwritten Laws of Engineering."

Bruce Eugene Del Mar of Santa Monica, Calif., received the junior award for his paper "Presentation of Centrifugal Compressor Performance in Terms of Non-Dimensional Relationship." The Charles T. Main Award was won by Jack Drandell of Milwaukee for his paper "Engineering in the New South." The undergraduate student award was presented to Ensign John Waldemar Erickson of Chicago for his paper "Increasing the Efficiency of Gas Turbines."

Cited for honorary membership in the Society were Rear Admiral Harold Gardiner Bowen, U.S.N., Naval Research Laboratory, Washington, D. C., for his services to his country; Dugald Caleb Jackson, professor emeritus, Massachusetts Institute of Technology, for outstanding leadership in education and consulting engineering fields; Audrey Abraham Potter, acting president and dean of engineering, Purdue University, for leadership in adjusting engineering education to the needs of war training; and Dr. Wong Wen-hao of Chungking, China, for his preeminence in the field of professional public service as vice president of the Executive Yuan and Minister of Economic Affairs and head of the National Reconstructioin Commission of his country.

GEORGIA TECH ESTABLISHES EMPLOYMENT OFFICE

In order to assure the southeast a fair proportion of the country's chemists and chemical engineers for research, for operation of proposed chemical plants, and for staffing of educational institutions and existing industrial plants, the Georgia School of Technology in conjunction with the American Chemical Society has opened a regional employment clearing office in the Department of Chemistry under the supervision of Dr. W. M. Spicer. The service will be available without charge to chemists, chemical engineers, and industrial employers. If personnel is not available in the area, the Georgia Tech regional office can obtain records of required personnel from the main office of the Society in Washington, D. C. the northeastern regional office at Boston University, and the other five regional offices still to be established.

CONVENTION CALENDAR

American Institute of Chemical Engineers, annual meeting, Stevens Hotel, Chicago, Ill., December 17-19.

American Association of Textile Chemists and Colorists, victory convention, Hotel Pennsylvania, New York, N. Y., January 3-5.

Society of Plastics Engineers, Inc., annual meeting, Horace H. Rackham Educational Memorial, Detroit, Mich., January 7-9.

Society of Plastics Engineers Plastics Exhibit, Convention Hall, Detroit, Mich., January 7-11.

American Society for Metals, annual convention, Statler Hotel, Cleveland, Ohio, February 4-8.

Technical Association of the Pulp and Paper Industry, annual meeting, Hotel Commodore, New York, N. Y., February 24-30.

Exposition of Chemical Industries, 20th exposition, Grand Central Palace, New York, N. Y., February 25-March 2.

Midwest Power Conference, annual meeting, Palmer House, Chicago, Ill., April 3-5.

The Electrochemical Society, Inc., national meeting, Tutwiler Hotel, Birmingham, Ala., April 10-13

First National Exposition of the Plastics Industry, sponsored by The Society of the Plastics Industry, Grand Central Place, New York, N. Y., April 22-27.

American Ceramic Society, 48th annual meeting, Hotel Statler, Buffalo, N. Y., April 28-May 1.

National Association of Corrosion Engineers, annual meeting, President Hotel, Kansas City, Mo., May 7-9.

Society for the Promotion of Engineering Education, 53rd annual meeting, Jefferson Hotel, St. Louis, Mo., June 20-23.

Fourth National Chemical Exposition, Chicago, Ill., September 10-14.

MATERIAL HANDLING SOCIETY FORMED IN PITTSBURGH

At a dinner meeting held last month at the Roosevelt Hotel, Pittsburgh, a group of men interested in material handling voted to form a society. The objectives of the new organization were expressed as to further the application of good material handling practices; encourage an interchange of ideas among the members; promote education and training in the science and practice of practical coordinated material handling; arrange for the collection and dissemination of information relating to all phases of material handling.

Temporary officers elected were T. O. English, Aluminum Co. of America, chairman and Richard Rimbach, Materials Publishing Co., secretary. Fred W. Bradley, National Starch Products, Inc., was chosen as chairman of the program committee; D. B. Hendryx, Harbison-Walker Refractories Co., chairman of the constitution committee; F. Gordon Ricker, chairman of the nominating committee; and Fred Benjamin, Kress Box Co., chairman of the membership committee.

SOLVAY PROCESS WILL BUILD LABORATORY AT SYRACUSE

Construction soon will be under way on a new research laboratory for the Solvay Process Co., a subsidiary of Allied Chemical & Dye Corp., at Syracuse, N. Y. The laboratory is being erected for the use of the research organization of the alkali division of the company and will be located within the present plant site. The company has a laboratory for the nitrogen division at Hopewell, Va.

GERMAN OIL INDUSTRY DATA MADE AVAILABLE

Important data on the German oil industry are being made available to the public at the Library of Congress and at about 30 libraries outside Washington, under arrangement with the Petroleum Administration for War and the Technical Advisory Committee of the Petroleum Industry War Council. The records have been declassified.

This information is divided into four categories: (1) About 150 microfilms of approximately 1,000 frames each, covering captured documents. The films may be

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ordered from the Library of Congress at a nominal charge; (2) indexes of the films describing the information contained thereon. Index copies may be examined at the Library of Congress and at the libraries outside Washington; (3) summary reports based on records and the work of investigators in Germany. About 40 reports were recently available at the libraries involved and others are in preparation. Subject matter includes Fischer-Tropsch synthesis, coal hydrogenation, lubricants and shale oil processing (4) summaries of information contained on the microfilms. These are or will be available at the libraries.

TWO PLASTICS EXHIBITS SCHEDULED FOR 1946

PLANS have been completed for the first postwar Plastics Show with the announcement that the Society of Plastics Engineers Plastics Exhibit will be held in the Convention Hall, Detroit, beginning on January 7 and continuing through January 11. The exhibit was postponed from the planned date in 1945 to avoid interference with wartime transportation demands. Fred Conley, chairman of the publicity committee says the floor plans show a greater area of exhibit space than ever before allocated to this type of industrial show.

The national annual meeting of the society also will be held in Detroit on January 7-9. The meeting will be held in Horace H. Rackham Educational Memorial with the business meeting, installation of new officers, and presentation of reports scheduled for the sessions on January 8. The annual banquet also will be held on that date.

The second exhibit will be held under the auspices of The Society of the Plastics Industry. As far back as its fall meeting in 1943 it was recommended that the society hold such an affair after the ending of hostilities. Recently a special committee made a survey to evaluate the benefits to be derived and acting on its findings, the society has announced that the First National Exposition of the Plastics Industry will be held in Grand Central Palace, New York, April 22-27.

Arrangements also are being made to hold the annual meeting of the society in New York at the time the exposition is in progress.

McGRAW-HILL TO PUBLISH *SCIENCE ILLUSTRATED*

ENTRY of McGraw-Hill Publishing Co. into the field of publishing a popular magazine was announced recently by James H. McGraw, Jr., president of the company. This will be done through the purchase of the magazine *Science Illustrated* which will cease publication until next April when it will appear under McGraw-Hill ownership. The revamped magazine will represent a new type of publication to bridge the gap existing between science and the public by interpreting the world of science in the public's own terms.

In addition to the consulting staff of 186 editors of other McGraw-Hill publications, the editorial board of *Science Illustrated* will include Dr. Gerald Wendt, editorial director; Harley W. Magee, editor; Dexter Masters, editorial consultant; Julian P. Leggett, managing editor; Arthur Wakeling, crafts editor; and Ariosto Nardozzi, art director. Willis Brown is publisher and general manager, George F. Seaman, advertising director, and E. Wood Gauss, promotion manager.

INTERNATIONAL MINERALS TO DEVELOP EXPORT TRADE

AS PART of its program to expand its phosphate division, International Minerals & Chemical Corp., has sent Commander George W. Moyers, manager of phosphate sales, to make a first-hand survey of phosphate markets in England, France, Belgium, and The Netherlands. He also will reestablish sales outlets in those countries to replace those suspended during the war period. Louis Ware, president of the company points out that the soil of Europe is badly in need of phosphate and after conferences with foreign bankers, is convinced that financing of purchases in Europe will offer no serious problem.

MIDWEST POWER CONFERENCE TO BE HELD IN CHICAGO

AFTER a year's lapse due to the war, the Midwest Power Conference will again be held in Chicago under the sponsorship of Illinois Institute of Technology. Cooperating with Illinois Institute of Technology in sponsoring the conference are nine midwestern colleges and universities and several engineering societies. Stanton E. Winston who was recently appointed director of the evening division of Illinois Institute of Technology is director of the conference for the seventh consecutive year. Headquarters will be at the Palmer House and the conference will continue over three full days, from April 3 through April 5.

OFFER COURSE IN CHEMICAL ENGINEERING ECONOMY

HOW TO step up chemical production at reduced costs will be the general subject matter of a graduate course in chemical engineering economy which will be offered at the Polytechnic Institute of Brooklyn during the second semester of the academic year 1945-46. Robert S. Aries, field director of the Northeastern Wood Utilization Council and chemical consultant specializing in the economic aspects of the chemical industry, will present the course consisting of 15 lectures which will give the application of the principles of economy to chemical engineering industries.

NO COTTON RESTRICTIONS PLANNED FOR 1946

RESTRICTIONS on cotton acreage in the crop year 1946 and on marketing quotas in the following season will not be established. This announcement was made in the middle of November, in accordance with provisions of the Agricultural Adjustment Act of 1938. It is probable that the supply of cotton seed and related products will be somewhat larger next year as a result of this action.

Two factors are involved in the decision,

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the labor supply, and the acreage of cotton which is planted. When all provisions of the 1938 act have been considered, a minimum of about 27 million acres is required before acreage allotments are mandatory. Since the planting in 1945 was of the order of 18 million acres, there is little likelihood that the 27-million-acre minimum will be reached in 1946. Shortage of official staff in the cotton-growing area also is such that emergency suspension of the acreage allotments and marketing quotas would be invoked.

BROMINE PLANT AT KURE BEACH WILL CLOSE

Operations will cease around the end of the year at the plant of the Ethyl-Dow Co. at Kure Beach, N. C. The plant was erected in 1933 for the extraction of bromine from sea water and has been in operation ever since. Production of bromine was considerably expanded during the war years. It is reported that the plant will be kept in standby position with the possibility that its closing may be but temporary.

TECHNICAL OFFICERS NAMED BY AGA

During 1946 the Technical Section of American Gas Association will be served by new officers elected at its recent convention, as follows: chairman, Lester J. Eck, vice-president, Minneapolis Gas Light Co., Minneapolis, Minn.; vice-chairman, C. S. Goldsmith, Engineer of Distribution, Brooklyn Union Gas Co., Brooklyn, N. Y.

JUNIOR ENGINEERS TO HEAR ATOM EVALUATED

"The Future of Atomic Power" will be the subject of an address by Philip W. Swain, editor of Power and of the new McGraw-Hill magazine *Atomic Power*, to be given January 15 before a joint meeting of the Junior Chemical Engineers of New York and the Junior Group of ASME's New York section. A dinner at seven o'clock and the meeting at eight will be held at Childs Restaurant, 196 Broadway, New York.

In discussing atomic fission as a practical source of industrial power, the speaker will emphasize the questions of cost, imminence, fields of use, and techniques of application. Mr. Swain has published several articles on this phase of the subject, the first appearing in Power as long ago as July 1940, and in recent months he has been engaged in gathering all available information for estimating sanely the course of future developments.

GOODRICH ACQUIRES ASSETS OF HYCAR CHEMICAL

Ownership of the Hycar Chemical Co. is now vested in the B. F. Goodrich Chemical Co. of Cleveland, a subsidiary of B. F. Goodrich Rubber Co. The Hycar company was formed during the war under the joint ownership of Goodrich and the Phillips Petroleum Co. This arrangement was made principally for the interchange of technical knowledge which would permit of early production of an oil-resistant butadiene synthetic rubber. Headquarters of Hycar will be transferred to Cleveland and production will continue at the Hycar plant in Akron.

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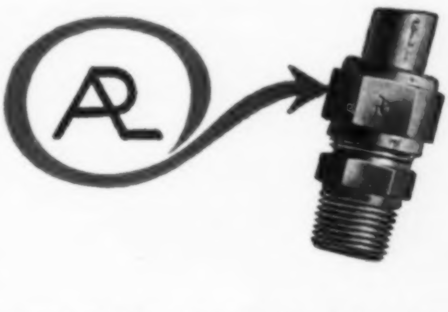

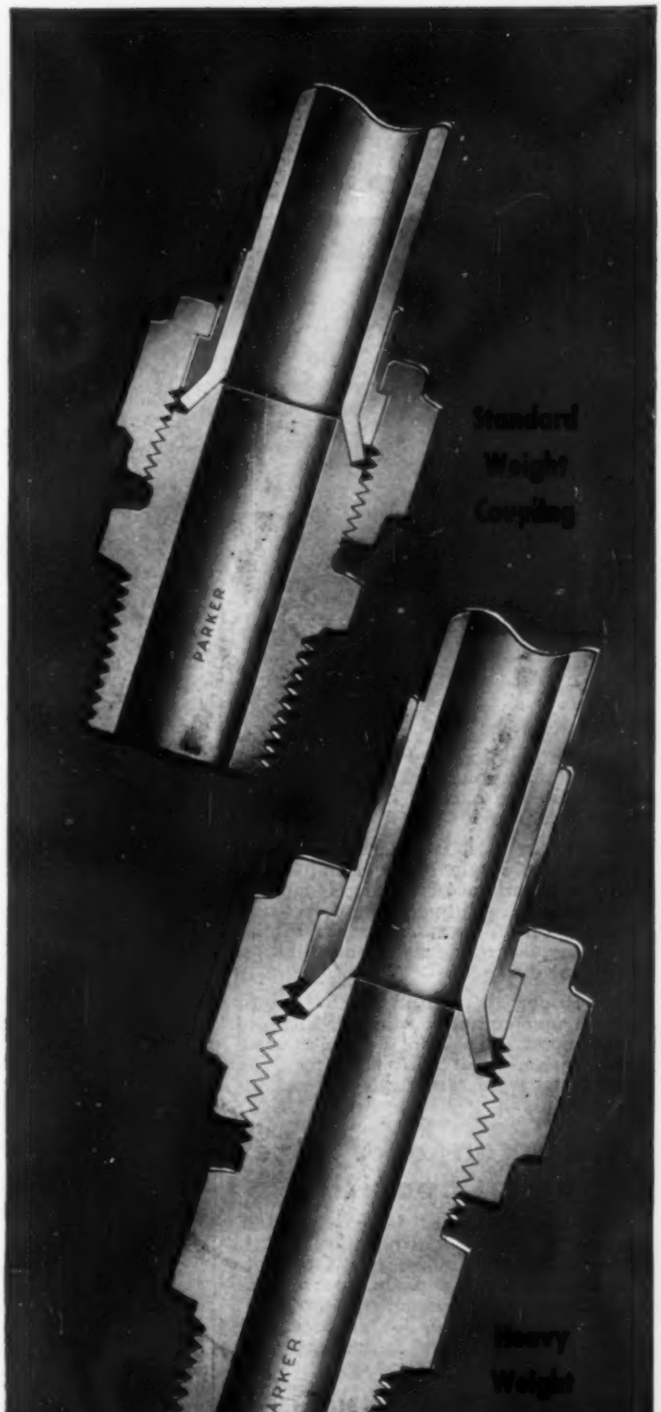

Note particularly the angle of the flare. It is scientifically set to provide maximum clamping surface, with equalized pressure all around. All stress and strain are taken on the body, nut and sleeve—there is full protection for the system against shock and vibration.

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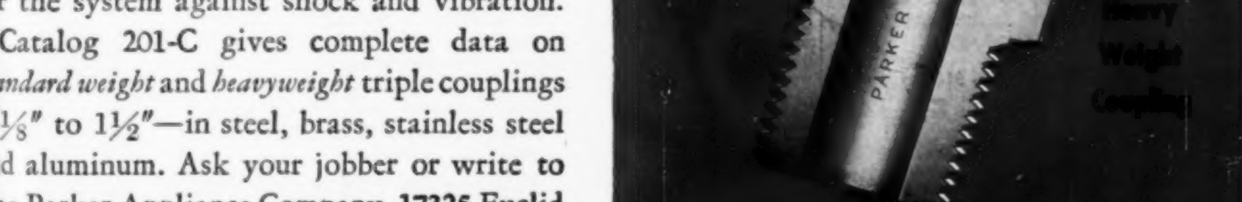

FLUID POWER PRODUCTS FOR ALL INDUSTRY

READERS' VIEWS AND COMMENTS

QUERY

To the Editor of Chem. & Met.:

Sir:—I have read with great interest the article on Mercury Cells in the July 1945 issue of *Chem. & Met.*

In the flowsheet on page 113 is mentioned that per ton of caustic soda you get 1,750 lb. of chlorine and 87,500 cu.ft. of hydrogen. This figure of 87,500 cu.ft. of hydrogen per ton of caustic seems rather high. Could you ask the author to check this figure?

D. N. CHAND

Machinery & Chemicals Ltd.
20/90 Connaught Circus
New Delhi, India

CORRECTION

To the Editor of Chem. & Met.:

Sir:—Regarding Mr. Chand's inquiry concerning the figure of 87,500 cu.ft. of hydrogen per ton of caustic soda. This is indeed an error and I appreciate having it called to our attention.

The figure should have been 8,750 cu.ft. of hydrogen per ton of caustic soda. The chemical equivalent of one ton of caustic soda is 8,980 cu.ft. of hydrogen at standard temperature and pressure. The figure of 8,750 therefore allows for some loss in collecting the hydrogen.

W. C. GARDINER

The Mathieson Alkali Works
Niagara Falls, N. Y.

INDEXES

IT HAS been suggested by Prof. Kenneth A. Kobe of the Department of Chemical Engineering at the University of Texas that we publish an index to the reports which *Chem. & Met.* has published since 1926. The Index, compiled with Prof. Kobe's help, is presented here.

An Index to *Chem. & Met.* Reports 1926–1945

(Continued on page 158)

STRUTHERS WELLS **NORTHMASTER**

Kneading Machines

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. . . their ability to do a better job, more economically.

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16 Page Technical

Bulletin

On Request

STRUTHERS WELLS CORPORATION

Northmaster Division, ERIE, PA.

Plants at TITUSVILLE, PA. and WARREN, PA.

Offices in Principal Cities

Report Index

(Continued from page 156)

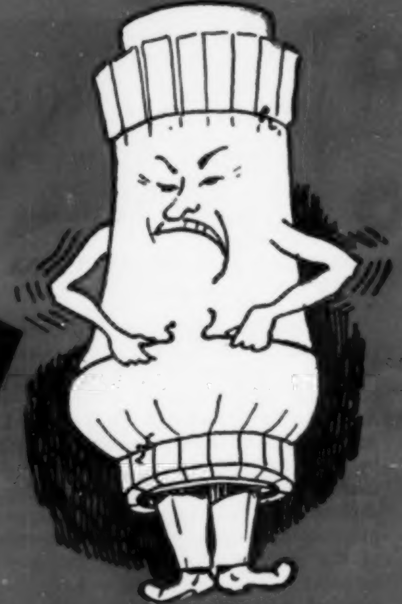
Index to *Chem. & Met.* Pictured Flowsheets, 1939–1945

(Continued on page 160)

Flowsheet Index

(Continued from page 158)

TROUBLED BY "MIDDLE-AGE SPREAD"?



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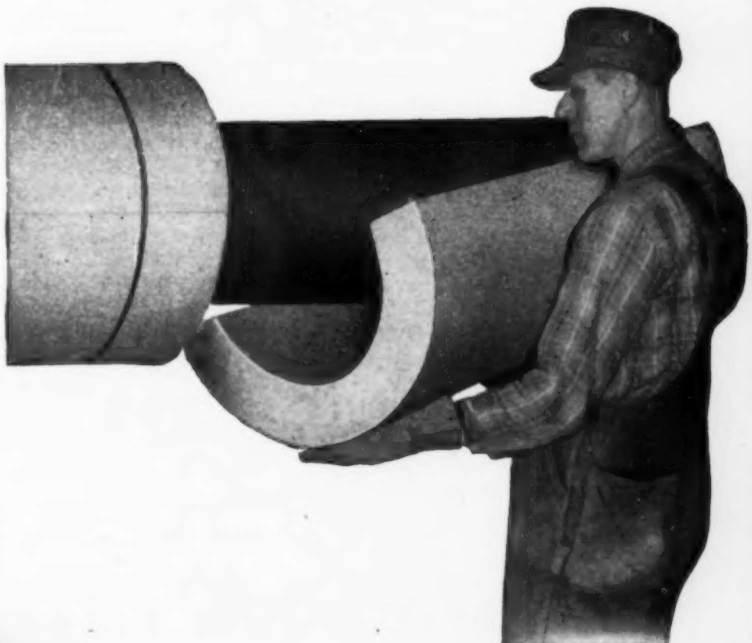

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PACIFIC PROCESS INDUSTRIES

TRENDS • EVENTS • DEVELOPMENTS

JOHN R. CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

AMERICAN POTASH AT TRONA EXPANDS RESEARCH

ADOPTING a long-range program of expansion in connection with increased recovery of chemicals from the natural brines of Searles Lake in California, the American Potash & Chemical Corp. of Los Angeles has announced plans for increasing by about 40 percent the technical personnel in its research and development department. First step in the announced program calls for a substantial expansion of the corporation's research facilities at its plant at Trona, near Searles Lake. New physical and analytical laboratories are to be provided, together with a chemical engineering laboratory for pilot plant assemblies. Additional office space and a new technical library are among the items planned for the immediate future. The new facilities are expected to be completed early in 1946. W. A. Gale remains as director of research, with headquarters at Trona.

For many years an outstanding pioneer in the application of physical chemistry in the separation of complex salt mixtures by fractional crystallization and other methods on a mass production basis, the firm has increased its output steadily until it now reaches well over 450,000 tons of primary products annually. Among the chemicals now produced from Searles Lake brine are potash salts, borax and boric acid, soda ash, salt cake and desiccated sodium sulphate, bromine and alkali bromides. Latest product is a lithium concentrate. Although much of the success of this enterprise has been due to the use of methods and types of equipment that are unique in the field of chemical engineering, officials of the firm believe that many possibilities still exist for further development, particularly in regard to new chemical products.

WEST'S SYNTHETIC RUBBER CAN COMPETE

SYNTHETIC rubber made in Los Angeles plants, now amounting to about 13 percent of the total United States production, can supply all western requirements in direct competition with the eastern product if the facilities, raw materials and plants continue to be utilized and operated properly and economically, according to a recent statement by Dr. G. M. Hebbard, deputy director of the office of Rubber Reserve. Now one of the most efficient plants in the country and with a unit production cost of raw rubber close to the national average, this $60,000,000 Los Angeles industry is unique in the close integration of basic raw materials and finished rubber goods, for within this area is the world's second largest rubber products manufacturing center. Finishing facilities include four large tire plants and 23 local factories. Intermediates for the synthetic rubber are produced in four plants within the area; the rubber itself is produced in two plants. Continuous instead of batch processing is now used in the polymer plants, the second such installation in the industry.

Synthetic GR-S rubber can compete with natural rubber both in price and quality, according to Dr. Hebbard, and passenger car tires of GR-S are now in production that will equal or exceed the service given by any standard brand of prewar natural rubber tires. By the early spring of 1946 synthetic rubbers will probably even have a definate edge on natural rubber from a price standpoint. In contrast to an output of 1.5 tons of rubber per man-year in the natural rubber industry, American synthetic chemical rubber plants can turn out some 60 tons of GR-S per man-year. There are no technical or economic reasons why synthetic rubber cannot become a permanent American industry nor why the present western plants cannot continue to supply all GR-S requirements of the region on a competitive basis.

RETORTS FOR OIL-SHALE UNIT OF N-T-U DESIGN

ANNOUNCING that the Southwestern Engineering Co. of Los Angeles had been awarded a contract for the design, fabrication and installation of two 40-ton-capacity retorts for distilling oil from shale at the $1,500,000 demonstration plant now under construction near Rifle, Colo., the Bureau of Mines revealed that the units would be of the so-called N-T-U type already proved to be adaptable to all types of American shale. Total cost of the retorts, installation of which is to be completed within five months, has been placed at near $190,000. The Rifle demonstration plant, which will serve as proving ground for processes being developed to convert oil shale into an auxiliary source of fuels and lubricants, is expected to go into production late next spring.

GENERAL ELECTRIC BUILDS CALIFORNIA RESINS PLANT

PLANS by General Electric Co. to build an alkyd resins plant on a 12-acre plot purchased in Anaheim, near Los Angeles, have been announced by N. L. Feininger, assistant general manager of the company's chemical department. The new project, now in the design stage, will be given over to the manufacture of Glyptal alkyd resins, primarily for use as paint base, from phthalic anhydride and a polyhydric alcohol such as glycerin. The unit will operate as a part of the resins and insulation materials division of General Electric's chemical department.

With ground on the project to be broken the first of January, it is expected that the plant will be in operations by August, 1946, and will employ approximately 35 workers. The plans include a process building, storage building, two pump houses, a boiler house and a gate house. All will be single story structures except the process building, which will be three stories. Total floor area will be 35,000 sq.ft.

This new Glyptal resins plant is in addition to the recently announced plastics plant now being designed for the same location for the plastics division of General Electric's chemical department. The plastics plant will be used for molding thermosetting and thermoplastic materials and for the fabrication of laminated materials. Both projects are part of the expansion General Electric plans in anticipation of the rapid increase in industrial growth of the Pacific Coast region within the next few years.

ALCOHOL CAPACITY GREATLY ENLARGED

WITH completion of the Willamette Valley Wood Chemical Co. plant in Eugene, Ore., productive capacity of the Pacific Coast industrial alcohol industry will approach 12,000,000 gal. annually, an increase of some 200 percent over prewar capacity and 300 percent over prewar production. The increase will be caused largely by the two new plants in the Northwest, the Puget Sound Pulp & Paper Co. in Bellingham, Wash., with a capacity of about 2,000,000 gal. annually and operating since the spring of 1945, and the 4,000,000-gal. Willamette Valley Wood Chemical Co. to begin operations early next year. Pacific Coast alcohol production in 1939 was 2,609,000 gal., practically all by the three California molasses plants, or 2.5 percent of total United States production. The accompanying table lists the present industrial alcohol plants in the west.

ROCK WOOL PLANT FOR TACOMA

WHAT is thought to be the first electric furnace in the United States to make mineral wool insulation will begin operations by the first of 1946, according to an announcement by C. Harold St. Johns, manager of the Everock Products Co. of

Present Industrial Alcohol Plants in the West

Company[3]	Plant Location	Raw Material
Bonneville Distilleries, Inc.[1]	Idaho Falls, Idaho	cull potatoes
Commercial Solvents Corp.	Agnew, Calif.	molasses
Lac Chemicals, Inc.	Culver City, Calif.	molasses
Puget Sound Pulp & Paper Co.	Bellingham, Wash.	sulphite liquor
U. S. Industrial Chemicals, Inc.	Anaheim, Calif.	molasses
Willamette Valley Wood Chemical Co.[2]	Eugene, Ore.	wood waste

[1] Started in 1939 as an experimental plant by the University of Idaho. [2] To be completed and operated in early 1946. [3] Does not include wineries and other beverage alcohol plants that temporarily produced industrial alcohol for war purposes.

Tacoma, Wash. Light colored insulation is to be made by the use of natural rock and lime. The capacity will be 12 tons daily at the start, with expectations of doubling the output within a short time. Loose and granulated insulation will be produced for the present. Closest competitive rock wool factories are now located in the San Francisco Bay area and in Salt Lake City.

MANY NEW WESTERN PLANTS SCHEDULED

Although largely unannounced, it is known that many new chemical and process plants have been definitely scheduled for the west. Most will probably go up within a year. Many other projects have been under actual consideration by various large firms, but it is more difficult to predict the outcome of such preliminary surveys. However, upon the basis of probability, some of the new plants the West can reasonably expect within the next year or 18 months include a large synthetic resins and plastics plant at Anaheim, Calif., a new sugar refinery in the Imperial Valley, a rayon plant in the Northwest, a sodium tungstate recovery unit in Southern California, a new seaweed processing plant at Santa Rosa, Calif., a fiberglas plant in California, a large heavy electrical equipment plant in the San Francisco Bay area, a $2,500,000 mono-sodium glutamate plant in San Jose, Calif., expanded formaldehyde facilities in California and an entirely new plant in Oregon, new facilities for recovering mercaptan chemicals from petroleum. Probably still in the planning stage are plants for making plastics in Los Angeles, tannin from western hemlock bark, powdered iron, petroleum coke, chemicals from ethylene gas, phosphorus and phosphoric acid, fertilizers, various materials form sulphite liquors, new insecticides.

FERTILIZER USAGE IN CALIFORNIA SOARS

Consumption of commercial fertilizers in California for 1944 increased to some 418,000 tons, according to data collected by the Bureau of Chemistry, California State Dept. of Agriculture, Sacramento, representing an increase of 39 percent over 1943 and of 99 percent over 1938. Most marked trend has been a sharp increase in use of mixed goods and most of the inorganic salts accompanied by a decline in the use of organic materials.

Use of agricultural minerals in the state has also soared to 507,000 tons in 1944 or an increase of 34 percent over 1943 and of 956 percent over 1938. Most outstanding increase has been in the use of gypsum which, as shown in the accompanying table, rose from 17,600 tons in 1938 to 394,500 tons in 1944.

FONTANA CHEMICAL PRODUCTION LARGE

Production of byproduct chemicals by the Kaiser Co. steel mill at Fontana, Calif., is appreciable; byproducts of this operation represent about 10 percent of the total materials handled. Principal byproducts at Fontana are produced by: (1) The 45-oven coke plant, which gives coke-oven gas, tar, ammonia, coke breeze and light oils; (2) the 1,200-ton blast furnace, which produces furnace gas, slag and flue dust; (3) the six open hearth furnaces, which produce slag and waste heat; (4) the rolling mills, which give roll scale and waste pickle liquor.

Coke-oven gas, in normal operations amounting to about 11,300 cu. ft. per ton of coal, is used for fuel by various Fontana units. Coke breeze or coke finer than 0.75 in., amounting to about 6 percent of total coke production, is used for metallurgical purposes, space heating and in the manufacture of building blocks. Coke-oven tar is distilled into several grades of creosote oil, heavy fuel oil and tar pitch. Average yields amount to some 60 percent creosote, 10 percent fuel oil and 30 percent pitch. Creosote oil, of which the plant can produce 3,768,000 gal. annually, is sold but the fuel oils are used in Fontana operations. Pitch, amounting to some 18,000 tons annually, is flaked and charged back into the coal mix. Ammonia is recovered and sold as ammonium sulphate to the fertilizer trade. Recovery of this chemical is at the rate of about 28.3 lb. per ton of coal, and capacity of Fontana for ammonium sulphate is in the vicinity of 9,100 tons annually. Light oils are processed to yield at maximum capacity some 1,600,000 gal. of benzol, 428,000 gal. of toluol and 200,000 gal. of xylol in

Commercial Fertilizers and Agricultural Minerals Used in California[1]

Fertilizer	1938	1939	1940	1941	1942	1943	1944
Ammonium nitrate	......	......	......	......	......	17,020	15,393
Ammonium phosphates	9,737	12,615	18,079	21,073	10,737	11,080	23,041
Ammonium sulphate	55,924	66,364	53,107	59,031	56,149	72,503	108,222
Blood and bone meals	3,708	3,395	3,810	3,852	2,149	798	999
Calcium nitrate	19,327	15,459	2,737	806	19	......	......
Cottonseed and fish meals	9,499	5,259	4,749	3,706	1,958	727	665
Mixed goods	66,993	61,519	70,773	88,009	109,156	147,778	183,696
Potash salts	1,828	2,492	1,973	2,249	3,466	2,215	2,226
Sodium nitrate	4,074	5,349	16,101	34,195	72,890	16,347	26,121
Superphosphates	10,599	13,841	14,730	16,449	26,039	15,241	35,697
All others[2]	29,106	35,802	34,523	41,225	20,157	17,741	22,246
Total fertilizers	210,795	220,431	218,589	267,372	302,720	301,450	418,306
Agricultural Minerals							
Byproduct lime	6,557	6,487	6,279	6,064	10,365	22,564	21,498
Gypsum	17,580	42,878	77,195	122,304	185,856	300,980	394,458
Hydrated lime	1,649	1,042	1,352	1,090	1,044	1,628	4,576
Mixed goods	4,352	5,358	2,424	2,490	2,853	4,396	4,364
Sewage sludge	......	......	......	......	22,549	21,286	29,192
Soil sulphur	3,635	4,562	5,193	7,535	7,720	18,364	36,974
All others	14,639	6,284	16,623	19,637	4,132	10,145	16,344
Total agric. minerals	48,412	66,611	109,066	159,130	234,539	379,363	507,316

[1] As tons per calendar year. [2] Includes miscellaneous, not segregated by registrant and corrected by audit.

addition to 100,000 gal. of solvent naphthas and 754,000 gal. of heavy residue fuel oil. Desulphurization of the coke oven gas yields sulphur, at present not utilized. Over 200 tons annually of sodium phenolate, from which phenol can be produced, is recovered at capacity operations.

Blast furnace gas, produced at the rate of about 5,000,000 cu. ft. per hr., is used at the plant as fuel although about 35 percent of this gas is surplus and is burned to the atmosphere. It could be used for the manufacture of dry ice or liquid CO_2. Approximately 250,000 tons of blast furnace slag is produced annually. This material can be used as a concrete aggregate or roadbed ballast or can be processed into rock wool insulating material. Flue dust is sintered for reuse in the furnace burden.

The open hearth furnaces produce slag at about the rate of 3,000 tons monthly. Some of this is charged into the blast furnace. The remainder could be used as an excellent soil conditioner because of its high phosphorus and manganese content and ability to neutralize soil acidity. Some 1,800 tons of roll scale per month from the rolling mills is charged into the blast furnace as a part of its regular burden. Waste pickle liquors, now discarded, could be treated for recovery of considerable amounts of ferrous sulphate.

CARBIDE PLANT RECONVERTED TO USE SMELTER SLAG

Planning to be in production by January, Independent Insulations, Inc., is now installing two 50-ton furnaces at the $1,000,000 DPC calcium carbide plant in Tacoma, Wash., recently purchased by the firm for the manufacture of rock wool insulation from Tacoma smelter slag. Provisions are being made for later installation of three additional furnaces, which will probably be coke-fired and of conventional design. Eventual capacity is expected to be in the neighborhood of 250 tons daily of bat and bulk insulation material. John B. Bridgeford is manager of the new firm, while T. C. Frerichs will be engineer in charge of the Tacoma plant.

NEW MINERALS MARKETS TO BE SURVEYED

With the purpose of stimulating a fuller economic utilization of California's minerals, W. W. Bradley, state mineralogist and chief of the Division of Mines, has announced formation of the Minerals Market Survey as a new branch in the Division's activities. The survey work, now being organized, will be conducted by Dr. Arthur A. Center, with headquarters in San Francisco. By concentrating on consuming and marketing aspects, Dr. Center hopes to develop new and larger markets for California minerals, especially for nonmetallics consumed largely by the chemical and process industries. Such raw materials as the salines, limestone, clays, sulphur ores, petroleum and natural gas, barite, gypsum and fluorspar are slated for detailed study. Engineers of the chemical and related industries are invited to submit their problems on mineral raw materials and treating agents to the Division for investigation.

Tying in well with this market survey work is the recently announced program for cooperative geological investigations by the Division of Mines and the U. S. Geological Survey on areas in the state having possibilities of greater production of economic minerals. The budget for this undertaking for the next two fiscal years, exclusive of overhead and publications costs, has been set at $200,000 and will be supplied equally by the state of California and the USGS. Dr. Olaf P. Jenkins, chief geologist for the state, will have charge of the state's cooperative efforts but the actual surveys will be conducted by USGS personnel. Slated for study are several localities of importance as potential producers of chemical raw materials.

CALIFORNIA MINERAL OUTPUT LARGEST ON RECORD

Largest in the history of the state, California's mineral production for 1944 reached a total value of over $469,774,000 or an increase of $43,329,000 over the total for 1943, recent statistics by the Division of Mines, San Francisco, have revealed. The value of the year's output of 62 industrial minerals was due chiefly to unprecedented demand for petroleum and natural gas. Bromine, dolomite, gypsum, lithia, natural gas, potash, pyrites and soda minerals all reached new heights in tonnage and value. Petroleum and salt registered new highs in tonnage yields. Of the saline, borates, bromine, magnesium salts, potash, salt, and soda (soda ash and salt cake) showed an increase in amount and volume; only calcium chloride and iodine showed a decreased output. Production of selected minerals used in chemical process industries were reported as follows:

Mineral*	Amount	Value
Bentonite, tons (17)	25,581	$180,065
Borates, tons (5)	234,860	5,264,884
Cement, bbl. (13)	14,599,752	21,249,520
Dolomite, tons (4)	217,018	619,425
Gypsum, tons (3)	905,981	2,360,694
Limestone, tons (18)	734,425	1,714,414
Magnesium and other, tons (5)	113,927	4,537,381
Natural gas, M cu. ft.†	467,743,259	31,797,418
Salt, tons (11)	709,873	2,060,989
Petroleum, bbl.†	311,717,804	330,659,802
Soda ash and salt cake (5)	299,574	3,047,630

* Numbers in parentheses indicate number of properties. † From an average of 20,313 producing wells.

NON-PROFIT RESEARCH SET-UP PROGRESSES

Hoping to get operations under way during January, the Pacific Research Foundation, a non-profit research organization recently incorporated in the state of California, continues to progress with its organizational work under the direction of Ernest L. Black of Los Angeles. A series of meetings with research and technical directors from both industry and universities gave encouragement to the group, while recent conferences with industry executives indicated that sufficient financial backing could be expected until the Foundation would become self-supporting. Present plans are to start on a modest scale and to conduct most of the laboratory work at universities and other cooperative institutions until the Foundation's facilities and staff could be expediently expanded. Projected major divisions of the organization would include those of chem-

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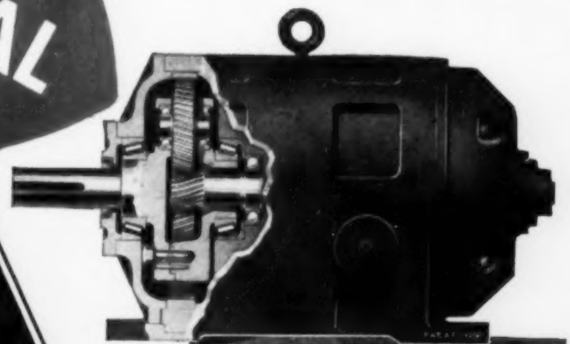
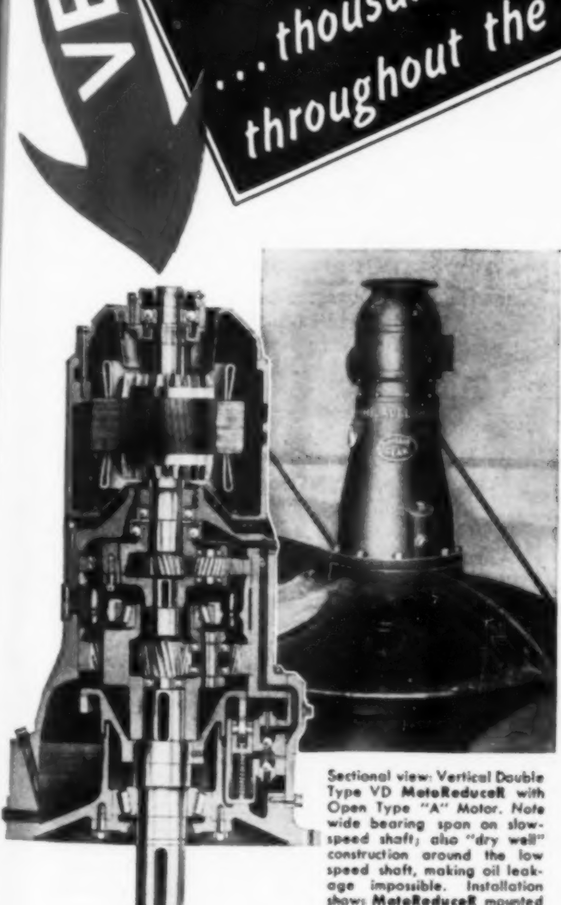


Sectional view of HS Open Type **MotoReduceR**: Note extreme compact construction, balanced base, and lack of overhung parts—neatness plus simplicity. Installation shows Horizontal **MotoReduceRs** driving conveyor belts in a flour milling company.



Sectional view: Vertical Double Type VD **MotoReduceR** with Open Type "A" Motor. Note wide bearing span on slow-speed shaft; also "dry well" construction around the low speed shaft, making oil leakage impossible. Installation shows **MotoReduceR** mounted on a mixing tank.

Here is the "very last word" in a self-contained, compact, smooth running, trouble-free Motorized Speed Reducer... the Philadelphia **MotoReduceR** is an "exclusive" product, and its design and construction is the result of 52 years' gear making and speed reducer experience.

Built in two types (Horizontal and Vertical), the **MotoReduceR** is the ideal combination of a high grade Motor and a Planetary Speed Reducer—a balanced, neat-appearing unit that operates with minimum vibrations and requires little or no attention. In addition every part is readily accessible; i. e. either the motor or the reduction gears may be removed without disturbing the others—and, they are easily bolted in place even in the most "out of way" places. Be convinced, send for new Catalog MR-45.

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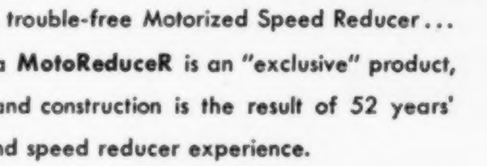


Industrial Gears and Speed Reducers
LimiTorque Valve Controls

istry, applied physics, metals and minerals, mechanics and hydraulics, wood, plastics and rubber, electronics and electricity, bacteriology and special projects.

Latest move of the Foundation is to obtain Dr. Henry T. Heald, president of Illinois Institute of Technology and of the Armour Research Foundation to make a comprehensive survey of the need, preferred location, and present usable facilities in the region. This survey, now under way, has been arranged for by Mr. Atholl McBean of Gladding, McBean & Co. It is hoped that a director for the foundation can be selected in the very near future.

Initial plans for the Pacific Research Foundation were drawn up by Dr. Maurice Nelles of the Lockheed Engineering Research Laboratory, who has just returned from several year's service as chief consultant of WPB's industrial process branch where he was associated with over 800 research projects placed in the laboratories of universities, industries and the nonprofit foundations for the government. Expenses of organizational work have been provided by Morlan A. Visel of Los Angeles.

UTAH CHEMICAL INDUSTRY STATUS SHOWN

The chemical and allied products industries of Utah now are second to the petroleum and coal products industries in both number of workers and monthly wages, according to recent statistics from the Utah Department of Employment Security. Since 1943, the new high-octane refinery of the Utah Oil Refining Co. in Salt Lake City has probably been the state's heaviest single employer in the petroleum field. According to recent reports, this $15,500,000 government-owned plant is likely to be leased or bought by private industry for continued operations. The following table summarizes the present status of these two processing industries.

	Chemicals & Allied	Petroleum & Coal Products
1944, Average		
Number of firms....	25	11
Monthly workers ...	713	918
Monthly wages	$197	$250
1945, First Quarter		
Number of firms....	21	9
Monthly workers ...	563	989
Monthly wages	$199	$253
1945, Second Quarter		
Number of firms....	21	8
Monthly workers ...	568	986
Monthly wages	$198	$269

DIFFERENTIAL ANALYZER GOES TO L. A. CAMPUS

A new differential analyzer capable of solving in a few days mathematical problems which would take several years of work by conventional methods has been purchased from General Electric by the University of California for installation on the Los Angeles campus, it is announced by Dean L. M. K. Boetler of the College of Engineering.

Sixth instrument of its kind in the entire United States, the new instrument was purchased with funds provided by the State Legislature for establishing a complete department of engineering on the Los Angeles campus. It will be one of the most important pieces of equipment to be housed in the engineering laboratories to be erected soon. Although the instrument will be housed on the Los Angeles campus, Dean Boelter pointed out that it will be available to all California for the solution of industrial and scientific problems such as those involved in heat transfer, electrical circuits, and engine vibration.

KAISER EXPANDS REFRACTORY BRICK OUTPUT

On the shores of Monterey Bay near Watsonville, Calif., the Permanente Cement Co. is erecting a plant, to be completed early in 1946. It will have a 100-ton daily capacity of high-purity periclase refractory brick to be made by the Kaiser-developed process of controlled blending and processing of magnesia and dolomite. The new plant, which will supplant the temporary unit at Milpitas, Calif., in operation for more than a year, will obtain magnesia from the seawater process of the near-by Permanente Metals Corp. The new firebrick, a large proportion of which will be sold to steel mills and smelters in eastern territory, has been in test use in electric and openhearth steel furnaces at Fontana, dolomite kilns at Natividad and a magnesia kiln at Moss Landing. Kaiser engineers feel that they have a product which is superior in durability and heat resistance.

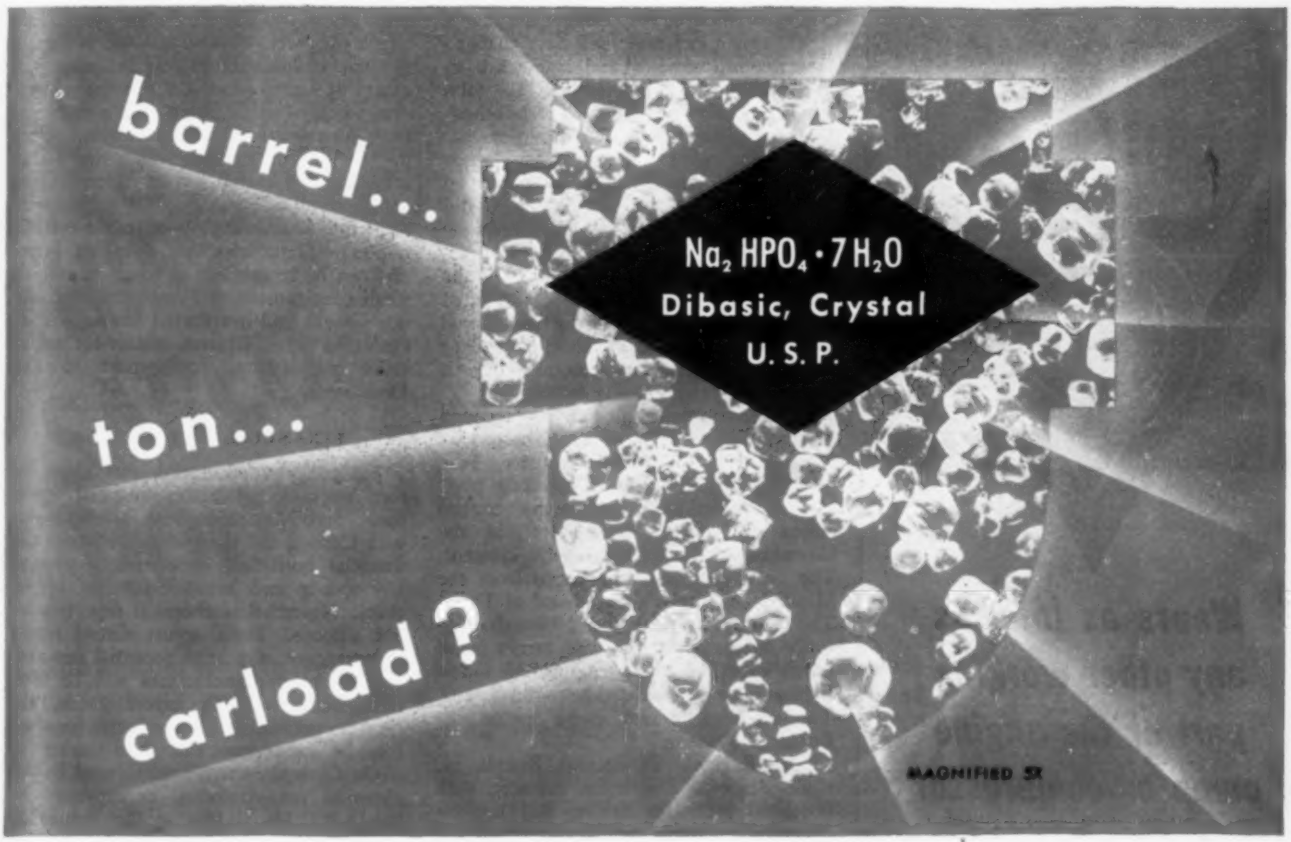
PLYWOOD PRESS TURNS OUT BIG SHEETS

Oversize plywood is now beginning to be made available to commercial distributors, according to E. E. Westman, president of Washington Veneer Co., Olympia, Wash., whose firm has just shipped its first full carload of big sheets for warehouse stock. One sheet was more than 50 ft. long and 5 ft. wide and was made by joining together several beveled standard-size panels and bonding with waterproof adhesive of the phenol-formaldehyde type. The new press for applying heat and pressure to set the adhesive at the joint is the largest of its type yet produced, having six openings, each 10 ft. long. During the war, most of the extra-big exterior-type plywood was shipped direct to government contractors. The plywood industry has become the major consumer of synthetic resin adhesives in the Northwest.

TEXAS CO. SETS UP NEW LABORATORY

Establishment of a technical service and research laboratory by the Texas Co., Pacific Coast Division, was announced by company officials earlier in the year. The new laboratory will carry out technical service and research activities connected with the drilling and production of petroleum and the processing of natural gas. Facilities are being enlarged through the erection of a research laboratory adjacent to the company's existing buildings at Signal Hill, Calif. The new building comprises seven research laboratories and a library. William W. Robinson, Jr., forerly chief chemist of the company's gasoline division laboratory was appointed chief chemist of the new organization with offices at Signal Hill.

SODIUM PHOSPHATE*, DI, U.S.P.



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NEWS FROM ABROAD

GREAT BRITAIN MAKES RAPID RECONVERSION PROGRESS BUT MANY WARTIME CONTROLS ARE CONTINUED

Special Correspondence

SIX MONTHS after V-J Day one in ten of all people in Britain will have changed from defense services and war work to peacetime pursuits: one-tenth of the total population, but of course a correspondingly higher percentage of the adult working population. This revolutionary transformation has so far been accomplished with a minimum of unemployment and upheaval, though also with less immediate gains in civilian production and consumption than might have been hoped. In the chemical trades with their wide variety of markets the volume of production is well maintained. The flow of labor, dependent upon the progress of demobilization, is the only effective limiting factor.

The Government, theoretically inclined towards State control of the economy, is in no hurry to de-control industry. Raw material controllers return to their posts in private industry, but many control offices survive as "directorates" in the Government's Raw Materials Department. The latter has been transferred from the Ministry of Supply to the Board of Trade. The Supply Ministry itself, though originally instituted for the war, carries on to watch over heavy and engineering industries and for centralized large-scale buying. The chemical trades come under the Board of Trade.

The Regional Production Boards become Regional Boards for industry, with functions much as before, and the co-operation between employers, workers and outside experts in individual industries is perpetuated on a national level by "working committees," whose specific task it is to make backward export industries efficient competitors in the world market. However, it is surmised they will spread to other trades, including chemical manufactures. With several other wartime Ministries—for transport, for food, and for fuel and power—continuing to function, chemical producers will thus have far more official contacts than before the war, and not everybody likes this development.

SUPPORT FOR EXPORTS

However suspicious of the Government's intentions in economic home policy, British industrialists can find no fault with its enthusiastic support of export trade. Broadly speaking, raw materials and shipping are now in good supply for orders from abroad, without differentiation between "hard currency" markets and others, and the labor shortage presents no insuperable difficulty for chemical exporters. Many of them find their order books fuller than ever, with Empire and European customers most pressing in their demands. It is hoped that more chemicals will before long be exempted from export licensing, though licenses are now obtainable without great delay.

A new difficulty, however, has arisen on the financial side. Some of the European countries soon exhausted the credits on which they were allowed to draw and cannot pay in kind for British manufactures except by luxury goods and other merchandise Britain can ill afford. Empire countries, on the other hand, have ample sterling balances in London which they naturally wish to use in payment for British goods, while Britain needs the proceeds from her current exports to pay for fresh imports. Sometimes the diverging interests can be reconciled, as when recently a small consignment of French essential oils was bought and distributed among British cosmetics manufacturers, mainly for use in toilet preparations for export to the Dominions.

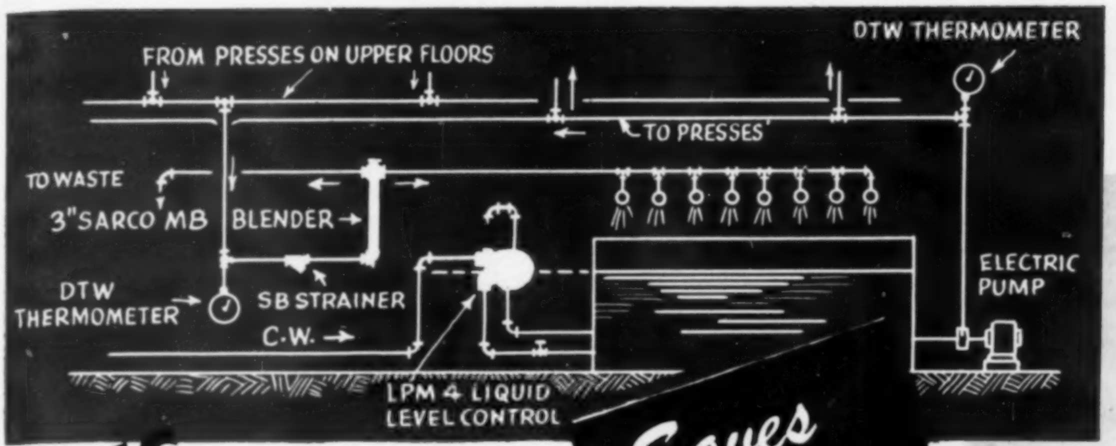
FINANCIAL BOTTLENECK

Pending the successful conclusion of the Anglo-United States financial agreement and the consequent arrangements with Canada and the sterling countries the financial bottleneck threatens to prevent any speedy and broad expansion of exports. Nevertheless chemical exporters are not anxious. Their agents abroad report the existence of a huge potential demand, and chemical manufactures will be foremost among British export goods, the more so as German chemicals will for some time be absent from the world market.

On Germany the official view of British chemical manufacturers, as expressed by the A.B.C.M., is that in the immediate postwar period of acute world shortage German chemical production might be needed to meet pressing demands, but this should be kept to the minimum and reduced as soon as Allied countries are able to take over. Consumers in all countries must, the A.B.C.M. agues, be prepared to go short if this is necessary to prevent the manufacture of potential war materials by Germany.

At home liquidation of the legacy of war is making good progress. Cancellation of war contracts was followed by the return under special arrangements to chemical manufacturers of surplus stocks left over in government departments. As these surpluses are handed back to producers who supplied them in the first instance, the latter are able to coordinate the disposal of war surplus supplies with their current sales, and in many cases they are glad to have the extra goods for their peacetime customers. The need for different arrangements for war surplus disposal has so far arisen in comparatively few instances. In general reconversion is greatly assisted by the urgency of the housing problem. Quite a number of armament factories will find employment in connection with the housing drive.

Indirectly the expected building demand seems to account for the biggest new venture yet announced since the end of the war, the formation of the £2,000,000 Associated Light Metal Industries Ltd. (Almin for short). The group, in which



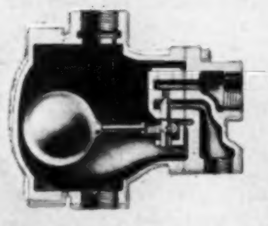
THIS SARCO HOOK-UP . . .

Saves $500 a month

The Sarco Blender is an automatic three-way valve that recirculates and controls temperatures.

A large plastics plant in New York uses a great number of hydraulic presses, which formerly were cooled by a 3-inch city water main running at full pressure with the returning water at 80 degrees.

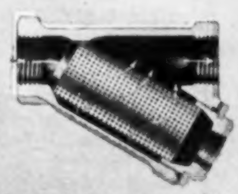
The plumbing contractor decided that something drastic and permanent should be done so he called in the Sarco representative, who recommended the circulating system shown above. Three little inexpensive Sarco products did the job and the monthly water bill of more than $500 has been reduced to $12 to $15 per month.



The Sarco liquid level controls are as simple as a float trap.

IT CAN HAPPEN IN YOUR PLANT!

Perhaps not to such a degree. Perhaps it's only a small loss of water multiplied at many spots, mostly invisible. But the Sarco devices used for recirculation and temperature control of tanks, engine jackets, brine coils, condensers, etc., cost so little that even a trickle of wasted water will pay their cost in a few months. The big saving is in the more efficient and reliable operation of the machines they control.



Sarco strainers are used to protect equipment, to clean river water, and strain oil, syrups, etc.

Many ways to save are shown in the Sarco Hook-Up Book and Sarco Catalogs. Many others applying specifically to your plant are available through the Sarco representative near you.

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FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

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Col. W. C. Devereux is the leading expert, includes International Alloys (with its subsidiary, Light Alloy Products), makers of light alloy ingots for remelting and working, and Renfrew Foundries (jointly owned with Rolls Royce, the motor manufacturers), and will establish two other major units, for the production of forgings and extrusions and for research.

A short while ago Imperial Chemical Industries announced that it would go in for large-scale production of light alloy products needed for building, and the Government intends to help the building drive by making fittings in idle ordnance factories; this will also entail light metal production. Such recent developments, however, suggest changes in organization of production rather than an expansion in outputs. The wartime concentration of the bulk of light alloy production in about a dozen big mechanized foundries may be followed by a vertical concentration of various stages of manufacture under single control. A similar tendency can be observed in the plastics industry (where another leading producer, British Industrial Plastics, has just set up its own subsidiary for making molds and jigs). Both in light alloys and in plastics, progress has been swift during the war, with the result that some retrenchment and consolidation, technical and financial, are needed now.

NATIONALIZATION OF COAL

The bill for the nationalization of the coal mines (the coal in the ground is already State property) may be introduced before the year is out. It will affect the chemical industries in two ways. First, nationalization is the prelude to modernization and rationalization, which have an important bearing on price policy. Secondly, coal processing prior to burning is likely to grow in importance. As the chemical utilization of imported and home-produced petroleum is soon to be encouraged by refund of import duty or subsidizing, it is not far fetched to expect the Government also to encourage coal distillation. The Minister of Fuel is known to be an advocate of coal processing in order to extract valuable ingredients before burning, and the impossibility of lowering mining costs gives support to efforts to reduce the cost of fuel by improved utilization of byproducts.

Besides, some of the collieries which have their pits taken from them against compensation while retaining, as seems likely, distillation and ancillary plants unconnected with coal mining proper, may wish to invest some of their liquid funds in coal processing works. The war has brought home the value of these works. Even now when benzol recovery is no longer compulsory gasworks and coke-oven operators have been officially asked to extract a maximum of light coal-tar oils, and the position with regard to other coal derivatives is not very different.

A new synthetic anti-malarial drug, to be distributed under the trade name of Paludrine, has been developed by an I.C.I. research team of organic chemists and biologists in collaboration with the Medical Research Council. The new discovery goes back to 1943 when the existence of anti-malarial activity was first noted in a class of compounds not previously explored. Clinical trials began in February last in the Liverpool School of Tropical Medicine, and since then supplies of the new drug have been flown to Australia for most extensive clinical trials.

As a result of these, the new drug is claimed to be not only more effective, but also considerably less toxic than either Mepacrine or quinine, but it is too early to assess adequately its value for the prevention of relapses. It is said to be considerably easier to manufacture than Mepacrine and to be much more powerful in action, one part of Paludrine being equivalent to at least three parts of Mepacrine or ten parts of quinine. In this connection it may be reported that an emergency aspirin factory erected by Aspro Ltd. with the most modern manufacturing and packaging machinery is now fully occupied in the production of Mepacrine, turning out over 2,000,000 tablets a day. The whole question of anti-malarial drugs will have to be reviewed in the light of wartime discovery and experience.

COMPANIA GOODRICH CUBANA HAS NEW MANAGER

Associated with The B. F. Goodrich Co. of Akron, Ohio, the Compania Goodrich Cubana, S. A., Havana, Cuba, through its vice president Russell F. Moody has announced the appointment of Colin M. Stewart as general manager. Mr. Stewart went to Cuba early in November to assume his new duties. He has been with Goodrich since 1934 and in January 1942 opened the Cleveland office of the company's automotive, aviation and government sales division which position he relinquished to take the post in Cuba.

NEW FERTILIZER COMPANY FORMED IN COLOMBIA

Organized in Colombia and sponsored by several government organizations, is a new fertilizer company which will be known as the Fabrica Colombiana de Abonos. It will have a capital of 4,000,000 pesos, the equivalent in United States currency of about $2,280,000. The plant now operating in Bogota will be enlarged. It has been producing 100 metric tons of bone meal a month. Raw materials are obtained from slaughterhouses in the vicinity and the plant makes two products—one for fertilizer and one for cattle food. It is planned to construct two new plants in western Colombia one of which may be located in Manizales.

BAUXITE PROCESSING AT SURINAM WORKS

The processing of bauxite to produce calcined ore which will be sold to abrasive manufacturers, is planned by a United States company operating in Surinam. The company will set aside one of the three kilns located at Paranam about 30 miles south of Paramaribo on the west bank of the Surinam River for this special drying process. To produce calcined ore, the kiln machinery must be adjusted to operate at a slower speed and the processing will take longer because more of the combined and associated water will be removed.

SHORTAGE OF COAL AND OTHER RAW MATERIALS SLOWS RECOVERY OF FRENCH MANUFACTURING INDUSTRIES

Special Correspondence

When France was liberated from German domination, her manufacturing industries were in a most unfavorable condition. In the first place a large part of the plant equipment had been shipped out of the country by the Germans and what was left behind generally had been overworked and was not in good condition. Even though plants and equipment had been left intact, any immediate return to large-scale production would have been impossible because the Germans had practically depleted the supply of all types of essential raw materials.

Hence the first requisite was to find a way to import a varied line of materials with special emphasis placed on machinery and coal. Here an almost insurmountable obstacle was found in an almost total lack of transportation facilities. The cumulative effect of enemy destruction was shown in the dislocation of all means of communication. Destruction of bridges, railroads and rolling stock, combined with the removal to German-controlled territory of locomotives, cars and trucks, made it difficult to carry on business of any kind. Of the locomotives France had prior to the German invasion, about one-fourth remained and many of these were capable of only limited service.

The situation was further complicated by the fact that French ports had been badly damaged by enemy action and considerable work—with consequent loss of time—had to be done before they could be used again. For a while what transportation facilities were available had to be given over to the pressing problem of moving Allied troops and supplies. Even with the ending of hostilities, in fact to a certain degree right up to the present, the use of railways and ports has been important in returning and disembarking the armed forces including French, English and American.

Gradually these difficulties have been overcome in part and the situation continues to improve but it will be a long time before French manufactures are returned to any thing like normal. The need for machinery and materials still is acute and the future rate of progress will depend considerably on the ability to import machine tools and special machinery.

Considerable planning has been done with a view of stimulating industry in the shortest time. Naturally this has resulted in the establishment of priorities with gasworks, power plants, railroads, and other basic industries getting the major part of available supplies. With their wants only partly met, it is obvious that some of the other lines including chemical plants have been able to get but small relief. Yet the chemical plants with the exception of Rouen and La Pallice, suffered little war damage and most of them can return to normal operations as soon as they get raw material supplies.

Turning to some of the more important chemicals it is found that sulphuric acid promises to be in small supply for some time. French production of acid is based on pyrites of which the country has an annual output of about 120,000 tons and acid requirements for pyrites run about 850,000 tons a year. Expectations are that Spain, Portugal, and Norway may supply 300,000 tons but if this should prove true, the supply for acid still would be far below normal. Naturally this does not give a favorable outlook for superphosphate manufacture. French agriculture has suffered from a curtailment of fertilizer as may be seen from the fact that consumption in the 1938-39 season was 1,500,000 tons while that for 1943-44 was 35,000 tons.

Nitric acid is not expected to be scarce and the output of hydrochloric acid will probably equal that of 1938. The alkali outlook is less favorable as the indicated output of soda ash and caustic soda will reach only about 10 percent of the 1938 tonnage. Bichromate production has been resumed and may reach 30 percent of anticipated requirements. Dyestuff plants have been slow to resume production with the shortage of coal a main factor and the output of dyes will be dependent on an improvement in the coal situation. Large imports of sulphur are scheduled for the next few months which will help the agricultural picture and July production of copper sulphate was reported at 4,000 tons.

SCARCITY OF FATS

Fats of all kinds have been scarce with the 1944 allocation amounting to but 5 percent of the 1938 figure. Some improvement has been noted recently but glycerine is in serious shortage and the same is true for glue and gelatin. Prospects are that only 15 percent of French needs for glue and gelatin will be met by home production. Industrial explosives are being turned out at a rate which is about one-half that of the last prewar year.

The plastics industry which had been forging ahead rapidly in the prewar era was badly affected by war developments and has been slow to pick up again which is explained by the lack of phenol and other coal-tar products. Hence, plastics are in a position similar to that reported for dyes and must await a reversal in the coal situation. Shortage of soap-making materials cut soap production last year to 15 percent of the normal prewar total. With fats and oils limited recent improvement in soap output has been slight but a toilet soap containing 40 percent fatty acids instead of the previous 20 percent is now being made and total production is now seen as reaching 6,000 tons a month.

Aluminum plants could use replacement parts but have been expanding outputs and have had a surplus which was exported. Glass plants likewise have made a good showing under the urgency of supplying glass for the windows of thousands of homes and buildings which had long been without that protection. Current window glass output is about back to normal.

Large quantities of sugar beets were left

to rot in the fields last year because there were no trucks or wagons to move them. A good part of what did find its way to processing plants was left to rot there because the plants were without power and could not process the beets. Sowings of sugar beets were reduced this year and sugar will be scarce for a long time.

French export trade necessarily must be small until such time as surplus goods are produced. At present the only commodity readily available for export is wine but again the lack of coal has cut down production of glass containers and proper packaging presents a real problem. The most serious drawback to initiating foreign trade, however, is found in the exchange situation. Manufacturing costs are high and French currency is deflated which has brought out the suggestion that some kind of government subsidy must be put into operation if business with outside countries is to be re-established.

EIRE PLANS INCREASE FOR DDT PLANT CAPACITY

Plans are under consideration in Eire for placing sale and manufacture of DDT on a relatively large scale. During a recent outbreak of infantile paralysis, DDT was used for spraying houses. A company in Galway has been turning out about 25 cwt. a week but will bring output up to 4 tons a week. Supplies of alcohol, sulphuric acid, and some benzene are obtained locally. All the chlorine used is brought in from England and some of the benzene also comes from that source. However, it is expected that all benzene requirements can be filled by the Dublin Gas Co. as soon as the coal supply permits larger operation.

PLASTIC ASSOCIATION FORMED IN INDIA

At a conference recently held in Bombay an All-India Plastics Manufacturers' Association was formed. The first step taken by the new organization was to urge that the government aid the new industry by facilitating the importation of machinery for the equipment of plants. Further it was stressed that there was a need for training more scientists and technicians both by providing increased educational facilities at home and by sending students to the United States and United Kingdom.

CHILE SELLS LESS NITRATE AND IODINE

In its annual report for the year ended June 30, 1944, the Sales Corporation for Nitrate and Iodine in Chile, placed sales of nitrate for the year at 1,051,000 tons and iodine at 1,128 tons. In each case sales and profits were reported at lower figures than for the preceding year.

MEXICAN TEXTILE COMPANY TO MODERNIZE PLANTS

According to a statement by the Office of Inter-American Affairs, The Industrial Co., of Orizaba, Mexico, one of the most important cotton-textile concerns in that country, will invest 25,000,000 pesos in new machinery that will permit greatly increased production. Hugh Torres, manager of the company, says the new equipment will replace much costly hand labor as well as transform other production phases. The company operates four plants and employs about 5,000 workers. A technical commission of the company has made a study with a view of re-locating the workers who will be affected by the change in production technique.

NEW CAUSTIC SODA PLANT IN TAMPICO MEXICO

Expected to be ready for operation in September a small plant for the production of caustic soda, was under construction during the summer months. It is located in Tampico, Mexico and is said to be the first of its kind to be erected in Mexico. The equipment was obtained locally from salvaged materials but some laboratory apparatus was to be imported from the United States and the soda ash to be used in the process also was scheduled to come from the United States. The output—planned for 35 to 40 metric tons a month—is expected to be sold to domestic soap plants and petroleum refineries.

SHARP DROP IN PRODUCTION OF ROSIN IN GREECE

Data for the first four months of the present crop season, show that production of rosin in Greece was far below normal. For the April-July period, the total amount dipped and processed or stored in distilleries is estimated at not more than 1,000 metric tons. There were some carryover stocks but total 1945 supplies are not expected to exceed 25,000 metric tons compared with an annual prewar figure of 20,000 to 25,000 tons. Domestic consumption for the first eight months of this year is placed at 300 tons of rosin and 250 tons of turpentine.

RESEARCH COUNCIL URGED FOR SOUTH AFRICA

A bill introduced in the Assembly of the Union of South Africa will, if it becomes law, direct that most of the research work done by the Education Department be taken over by a new Scientific Research Council which will be created. The purpose of the Council would be threefold: better application of scientific research to the Union's natural resources and to industry; proper coordination of research among all bodies and institutions; and the fostering and training of research workers.

SUPERPHOSPHATE SCARCITY IN AUSTRALIA

The shortage of fertilizers in Australia, particularly superphosphates, is expected to be more noticeable in western Australia although the amount to be made available will be above the low level of the past season. Superphosphate supplies in all sections are considerably below normal but the central and northwestern wheat-growing areas of New South Wales are much less dependent on this material. The drought in the southern part of the state gave the wheat lands a rest so that amounts of fertilizer needed are subnormal.

GERMAN CHEMICAL INDUSTRIES

AVIATION GASOLINE FROM COAL

Information was obtained on the method of preparation of aviation gasoline generally being followed in Germany where, briefly, bituminous coal or brown coal tar is hydrogenated in several stages; the butane from the hydro-plant is fractionated into normal and iso-butane; the normal butane is dehydrogenated, (DHD Process) and the resultant butylene alkylated with the iso-butane to produce aviation alkylate; the gasoline fraction from the hydro-plant (hydro-petrol) is rerun, the heavy naphtha fraction in dehydrogenated to yield a high aromatic content naphtha, which is blended with the alkylate, and the light fraction from rerunning the hydro-petrol. The final blend with 5.6 Tel per Imp. Gal. tests 95-96 octane no., Motor method, and 150 blending Index, rich rating. In a new single step hydrogenation process (TTH) reported to be in operation at Zeitz. Brown coal tar is hydrogenated in the liquid phase with 5055 catalyst (Florida clay plus chromium and molybdenum oxides) yielding a low quality gasoline, 5 cetane no. diesel oil and wax. The wax is well suited for synthetic lubricating oil manufacture by cracking to olefines, polymerizing with aluminum chloride and clay finishing.

SODIUM PERBORATE

Sodium perborate, up to 1939, was manufactured at Henkel & Cie A.G. Dusseldorf, by the conventional electrolytic process. At that time production ceased and the equipment facilities so far as practical converted to the manufacture of hydrogen peroxide. The contributing factors responsible for this conversion were undoubtedly the more urgent need of hydrogen peroxide by the German Army and the unavailability of borax in adequate amounts.

The method was more or less continuous and proceeded in two basic steps; the first was chemical, and the second electrochemical. Borax and soda ash were dissolved in water to the proper concentratoins to yield $NaBO_2 + H_2O$. The solution of the first step was next electrolyzed under the correct conditions with the resultant formation of hydrogen peroxide. The hydrogen peroxide then combined within the cell with sodium borate to produce sodium perborate.

The cells are circular in shape and constructed of rubber-lined steel. They have an effective operating volume of 3,000 liters each. Twenty-four cells connected in electrical series comprised the production layout.

The cathodes were iron and the anodes were a group of small platinum wires all tied together physically and electrically. The platinum wires are electrically shunted to rubber coated aluminum supporting conductors.

All cells are jacketed and provide for circulation of cold water around the bath for control of electrolyte temperature, which is very necessary.

For more effective control of electrolyte temperature a cooling coil is arranged inside of cell parallel to cell walls and provides for circulation of water externally cooled by refrigeration.

All cells are individually provided with motor driven stirrers to facilitate the reaction. Cells are also provided with an automatic electrolyte overflow pipe which connects into a cell electrolyte withdrawal vent located at bottom of cell.

The initial electrolyte consisted of 140 gm. per l. sodium carbonate plus 40 gm per l. of borax. The total concentration represents approximate saturation at 10 deg. C.

Under normal operation the electrolyzed solution is periodically withdrawn through a valve at the bottom of each cell (along with sodium perborate crystals) and regenerated outside after removing the sodium perborate crystals.

Regenerated electrolyte is pumped back into cells more or less continuously. Electrolyte temperature in cell is maintained at about 12 deg. C. by the artificial cooling.

Total average current load for the 24 cells operated in electrical series was 11,000 amp. The electrical drop across each cell at 11,000 amp. load was approximately 6 v.

The electrolyzed solution is withdrawn through a valve located at bottom of each cell and passes into a centrifuge where the sodium perborate crystals are separated from the mother liquor. The mother liquor passes to a regeneration container, first readjusted chemically to the proper borax and soda ash content, and then pumped back into the top of each cell. The moist centrifuged sodium perborate crystals pass from centrifuge onto an endless belt conveyor to a dryer and screen, and thence to proper holders.

To produce 1 metric ton of sodium perborate crystals, the raw material consumption was: borax, 630 kg.; soda ash, 17 kg.; caustic soda, 127 kg.; magnesium silicate, 3 kg.

SYNTHETIC GLUE

Henkel & Cie A.G. has been engaged in producing glue synthetically in an amount stated to be from 40 to 60 metric tons per month. The process is essentially as follows. Melamine in the amount of 1,800 kg. is mixed with 1,200 kg. of a 36 percent aqueous solution of formaldehyde in an open vessel and agitated for a period from 1½ to 2½ hr. Melamine dissolves in the formaldehyde solution. The liquid mixture is withdrawn into two revolving digesters operated at 150 deg. C. From these the mixture passes into two open flat pans and solidifies as a resin in 24 hr. It is allowed to stand for an additional 3 days. The solidified resin glue is next removed from the pans, pulverized, and packaged.

WATER RESISTING VARNISHES

Imported sulphate pulp residues are purified and worked up into resin acids which are usually esterified to yield water resisting varnishes.

The crude raw material is decomposed

with sulphuric acid, washed and thoroughly dried in a vacuum. The product contains about 50 percent resin acids, largely phenanthrene derivates with about 20 carbon atoms. This is known as Rohtalloel. By centrifuging, a pale yellow solid containing 90 percent abietic acid has been obtained.

The Rohtalloel is distilled at about 280 deg. C. and 12 mm. giving 80 percent "Talloel" and 20 percent sulphate pitch which is sold for waterproofing felt, etc. There appears also to be a small light fraction of no special interest.

The Talloel is esterified with glycerin, or glycerin substitute (apparently a mixture of glycerin, glycol and other substances known as oxydpech obtained from I.G.). Pentaaerythritol from I.G. has also been used with success. The product forms rather slowly, drying but very waterproof films.

Judging from experience with lac, these films, though good in some respects may fail in others. They can be made in very many varieties. The acid value of the product is usually about 6

POLYVINYL CHLORIDE

IN THE I. G. organization vinyl chloride is made chiefly at Schkopau with a small amount at Rheinfelden. Acetylene and hydrogen chloride are combined in the presence of a mercuric chloride catalyst. The monomer is stored or shipped in steel tanks under nitrogen at 10-12 atm. pressure.

The standard process is emulsion polymerization in a mixture of 100 parts vinyl chloride, 100 parts water (purified by double ion exchange with phenolic and aniline resins), 4 parts Mersolate (sodium salt of C_{12}-C_{18} Fischer-Tropsch hydrocarbons with chlorine and sulphur dioxide), and 0.4 part of 40 percent hydrogen peroxide. A 90 percent yield of polyvinyl chloride is obtained.

A wide variety of mixed polymers is made by I. G. Farbenindustrie AG. The compositions and tonnage (short tons) produced in 1942, of the various products made with vinyl chloride are given in the following table:

Igelit Type	Composition		1942 Production, Tons
	Vinyl chloride (VC)		2,216
PCU	Polyvinyl chloride (PVC)		970
PC	Chlorinated PVC		907
MP-A	VC	80	621
	Dimethyl maleate	10	
	Diethyl maleate	10	
MP-K	VC	84	882
	Methyl acrylate (MA)	16	
MP-AK	VC	80	307
	MA	13.5	
	Diisobutyl maleate	6.5	
MP-400	VC	73	116
	Vinyl isobutyl ether	27	
MP-8	VC	55	6
	Vinyl acetate	45	
MP-D	VC	80	1.4
	MA	20	
MP-VB	VC	85	1.6
	Butyl Acrylate	15	

The Wacker firm produces three grades of polyvinyl chloride: Vinnol HH, K = 70-80; Vinnol H, K = 65-70; Vinnol K, K = 60.

The most commonly used measure of the molecular weights of vinyl chloride polymers in Germany is the Fikentscher K value. This is an empirical value determined by measuring the viscosity of 1 percent solution of the polymer in cyclohexanone. Fikentscher's viscosity coefficient, K, is calculated as follows:

$$\frac{\log n}{c} = \frac{75\,K^2}{1 + 1.5\,K\,c} + K$$

where c is the concentration in g. per c.c. of solution and n is the ratio of the viscosity of the solution to that of the pure solvent.

At Ludwigshafen it was preferred to use the M number as a measure of the degree of polymerization. The M number is determined by dissolving 1 g. of polymer in a solvent consisting of 1 part of epichlorohydrin to 3 parts of chlorobenzene, heating to dissolve, and cooling to gelling temperature. Sufficient solvent is added until the gelling temperature is 20 deg. C. and the c.c. of solvent required is the M number.

Vinnol is said to have better electrical properties than Igelit because the finished washed products contain only about 0.1 percent emulsifier, polyvinyl alcohol. Vinnol was supplied for use as cable covering.

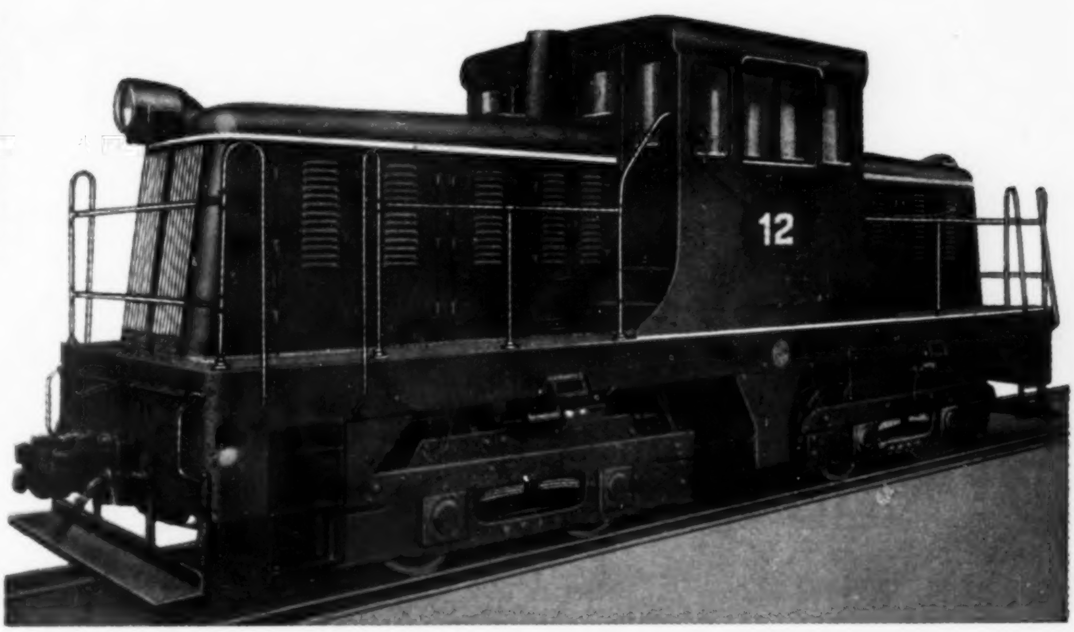
Igelit PCU is used unplasticized for the production of approximately 2,000 tons per year of Vinidur sheets, rods, tubes and moldings. It is heated on rolls at 160 deg. C. and then extruded as rods by flash heating to 190 deg. C. Apparatus for the continuous production of press polished sheets was developed experimentally at Bitterfield and Troisdorf, but has not been operated successfully. No satisfactory stabilizer for polyvinyl chloride has been found and the Vinidur products are always discolored brown. Sodium carbonate or phenyl indole stabilizer neutralizes the liberated hydrochloric acid. The Vinidur products are very resistant to chemicals, both acid and alkaline, below the softening point, 60-70 deg. C. They can be welded or may be cemented with a solution of Igelit PC.

Unplasticized polyvinyl chloride is also used to produce film of 1.0 to 1.4 mil thickness. The process employed in making this film, called "Luvitherm."

Luvitherm is the first dry-processed unplasticized polyvinyl chloride film made in Germany. It is of immediate interest as a packaging material for protection against tropical conditions. Heat sealing is difficult because the tack point is high, but the film can be cemented by the use of cyclohexanone or tetrahydrofurane and pressure.

The plasticizers used in compounding polyvinyl chloride are tricresyl phosphate, triethyleneglycol caproate, triethyleneglycol dihexoate, trihexyl phosphate and dibutyl phthalate. New plasticizers, called "Elaols," were made by esterifying glycols with the lower members of the fatty acid series (C_5-C_9) produced by the oxidation of Fischer-Tropsch paraffins, which consist mostly of straight chain hydrocarbons. Elaol I is the triester of hexanetriol with the fore-run fatty acids in the range C_5-C_7; similarly Elaol II is made with fatty acids in the range C_7-C_9. About 40 percent of Elaol with a little tricresyl phosphate or dibutyl phthalate, gives "Mipolam" with good cold and water re-

70-ton, standard-gauge Diesel-Electric Locomotive for large steel company. Equipped with two complete power plants, four traction motors and dual control for operation with equal convenience from either side of the cab.

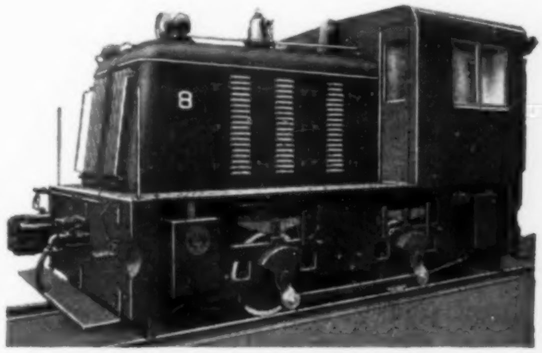


Diesel-Electric Locomotives

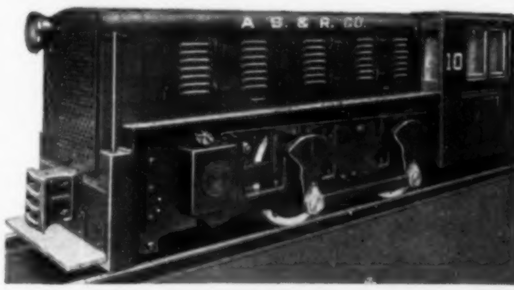
to meet Specific Requirements

Like all other types of locomotives the Diesel-Electric can only attain its highest degrees of efficiency and economy when precisely suited to the work required and to the conditions under which it must operate. For this reason Vulcan has standardized its designs to only a limited extent—leaving its engineers free to cooperate with the purchaser's engineers or executives in modifying clearances, body designs, gear ratios, etc., to meet their specific requirements.

As indicated by the examples here illustrated this policy of "flexible standardization" usually enables us to give better service than would otherwise be possible and has aided materially in establishing the high esteem with which Vulcan Diesel-Electric Locomotives are regarded by many well-known users. Detail promptly on request.



25-ton, 60"-gauge, Diesel-Electric Locomotive for service in the Canal Zone. Equipped with one complete power-plant, one traction motor and counter-balanced side rods.



14-ton, 24"-gauge, Diesel-Electric Locomotive for large smelting company. Equipped with one complete power plant, one traction motor, and counter-balanced side rods. Designed to operate under conditions of limited height and width.

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Diesel and Gasoline Locomotives	Rotary Retorts, Calciners, Etc.	Heavy-Duty Briquetting Machines	Self-Contained Electric Hoists
Diesel-Electric Locomotives	Improved Vertical Lime Kilns	Ball, Rod and Tube Mills	Scraper-Loading Hoists
Electric Locomotives and Larrys	Automatic Quick-Lime Hydrators	Shaking-Chute and Chain Conveyors	Cast-Steel Sheaves and Gears

sistance, satisfactory for cables and soft rubbery products. In general, phenoxyacetic esters made with glycols were observed to be best for high temperature resistance; aliphatic esters are best for low temperature resistance.

The chlorinated polyvinyl chloride is made by treating a 10 percent solution of PVC in tetrachloroethane at 90 deg. C. with chlorine for 24 hr. It is used for PC fibers and bristles, chemical resistant coatings, and Vinifol films for packaging and electrical insulation.

Igelit MP-A, stabilized with sodium carbonate, is used without plasticizer for the production of rigid, press-polished transparent sheets, marketed under the trade name "Astralon." The applications of this nonflammable transparent plastic include dials, signs, windows, drawing instruments, playing cards, and slide rules. Igelit MP-K is used largely for extrusion over cables, being more flexible than A. Igelit MP-D is the same as MP-K except that the emulsifier has been washed out; it is used for dentures. Igelite MP-AK is employed for transfer molding of storage battery cases. Igelit MP-400 is useful in adhesives and lacquers because it dissolves easily in ordinary solvents and has excellent adhesion and resistance to water, acids and alkalis. The vinyl ethers are cheaper than the acrylic esters; hence, these copolymers are thought to have a good future.

SYNTHETIC FATTY ACIDS

Synthetic fatty acids have been produced on a large scale in Germany at a number of different plants. They have all used a similar method, which consists of the oxidatoin of paraffins (normally from the TTH hydrogenation process on lignite) by air, using the same method as that worked by the Pasco Co. of America, who hold licenses from I.G. allowing them to use the patents. The following companies are engaged in this work: I.G. Oppau (20,000 tons per yr.); I.G. Heidebreck Upper Silesia (20,000 tons per yr.); Deutsche Fettsaurewerke Witten Ruhr (40,000 tons per yr.) A further plant is under construction at Magdeburg for the Hubue and Fahrenholz Fabrik, but is not completed.

The first fraction, consisting of C_1-C_4 acids, is recovered from the effluent gases by cooling and absorption in water. The formic acid is used mainly for the treatment of fodder silos, the acetic and butyric for the esterification of cellulose, and the propionic is used in the form of calcium propionate as a preservative in bread.

The C_5-C_{10} acids which are insoluble in water are obtained as the first fraction of vacuum distillation, and by further distillation they can be separated into the C_5-C_7, C_7-C_9, and C_9-C_{11} fractions. The first two are hydrogenated to the corresponding alcohols, and reacted with phthalic anhydride to give glyptal resins. The C_7-C_9 fraction also finds application in fire extinguishers of the foamite type. The C_9-C_{11} fraction is normally used for the separation of minerals by flotation.

The C_{10}-C_{18} fraction, next isolated by vacuum distillation at 3 mm. pressure, is used directly for the production of soaps

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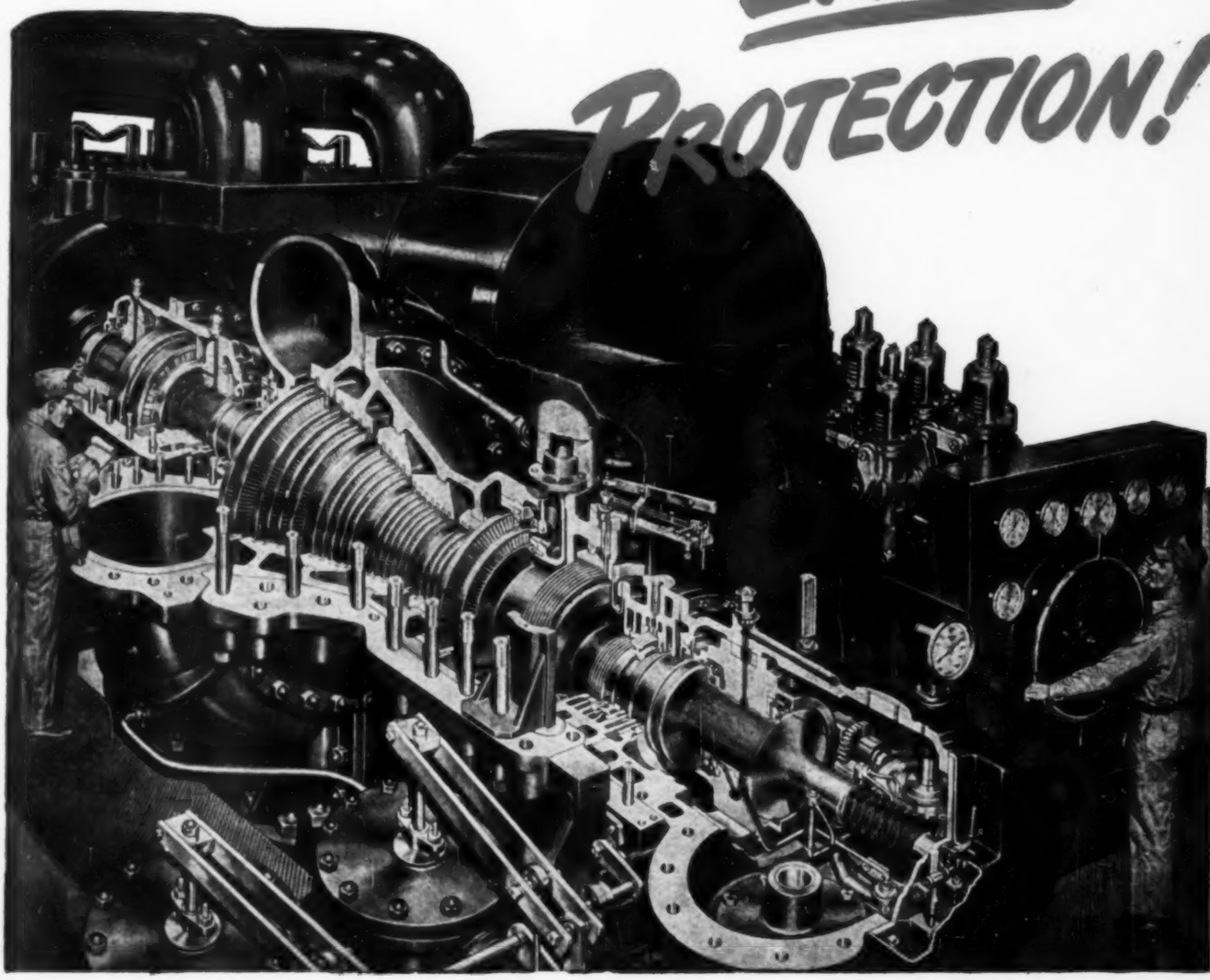

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The new oil—Gargoyle D.T.E. Oil 797—has extra resistance to oxidation and rust added to a base stock that is in itself an excellent turbine oil. In severe tests, it has stood up longer than all other leading turbine oils.

This is typical of Socony-Vacuum's continuous research on Correct Lubricants for every machine you operate—turbines, Diesels, steam engines, pumps, compressors, gear sets, electric motors and so forth. Great new developments are in progress in every field; extras are being added to the famous Gargoyle oils and greases—to assure even greater machine operating efficiencies.

Why not be sure now, that you are getting all these extra benefits in lubrication for *your* entire plant.

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and edible fats without further separation although for edible fats a slightly lower fraction 6_9-C_{16} is normally employed. For edible fats it is also necessary to remove the dicarboxylic acids by treatment with dilute sodium hydroxide. Very little edible fat was made at Oppau, but the Deutsches Fattsaurewerke produced about 1,800 tons per yr. The edible fats appear to be of excellent quality.

The C_{18}-C_{24} acids are isolated as the next higher fraction from vacuum distillation at 3 mm. pressure. They have found application in greases as sodium, calcium and lithium soaps and also in combination with triethanolamine, as softening agents for leather. The zinc, magnesium, and calcium soaps have also been used as lubricants for plastic molding.

The pitch residue of the distillation is used in lacquer production, as a molding agent for foundry cores and especially in the manufacture of artificial vaseline. This latter preparation is carried out by ketonization, followed by hydrogenation by which long chain saturated hydrocarbons are obtained which are claimed to be an excellent substitute for vaseline. The pitch can also be hydrogenated directly to alcohols and glycols which are used as softeners in certain plastics.

A small proportion of I.G. Kaurit-Leim (a phenol-formaldehyde resin) was sometimes added to soap made from synthetic fatty acids to render them softer but no additives were used to improve detergent properties. The I.G. had not engaged in the manufacture of sulphonated detergents of the sulphonated lauryl alcohol type.

In connection with the use of the C_{18}-C_{24} acids in grease manufacture, they found that the addition of 2 percent calcium benzoate to a soda base grease made with synthetic fatty acids would render it water resistant without lowering the melting point which was of the order of 200 deg. C. The exact proportion of calcium benzoate was varied a little according to the type of fatty acid concerned.

Aluminum stearate and similar products from mixed fatty acids were made at Ludwigshafen on the pilot plant scale but there was no large scale production. They were used in waterproofing and also as thickening agents for lubricating oils. A little work had been carried out on their use as thickening agents for petrol in an attempt to produce a compositoin similar to that found by the analysis of one of our incendiary bombs, but this had not been completed. No work appears to have been done by I.G. on the possible use of thickening agents of this type for fuels for flame throwers.

NEW LIQUID INCENDIARY AGENT

Prior to 1937 a Dr. Kwasnik began an intensive study of fluorine compounds since the I. G. plant at Leverkusen was interested in obtaining a good fluorinating agent for the fluorination of hydrocarbons. Iodine trifluoride was prepared and tested for the fluorination of hydrocarbons with some success. As a matter of scientific interest, chlorine trifluoride was prepared and found unsatisfactory for the purpose just mentioned. The Inorganic Division

had found no use for ClF_3 and had no interest in it until 1937 when the German Army Ordnance inspected the laboratory preparing the material. The Army subsequently asked for samples at intervals; the first sample was sent about four years ago, the last in 1944. During this period the laboratory prepared 3 to 5 tons of ClF_3. It is believed that the German Army intended to use ClF_3 in shells against aircraft and tanks.

Structure of the substance is not known. It is a liquid with a boiling point of 12 deg. C. When stored in iron pressure cylinders, the material is stable and can be handled and shipped without difficulty.

The substance combines with all organic and a number of inorganic compounds so vigorously that the heat generated will generally cause the material to burst into flame. Combustible organic compounds will then continue to burn in the normal manner. Non-combustible inorganic substances cease to flame as soon as the ClF_3 is dissipated. Glass, for example, would be badly etched and rendered opaque by contact with ClF_3. Glass wool is said to burn with a flame in the presence of ClF_3 and the reaction with water is so vigorous as to give off incandescent gases.

Process of manufacturing is as follows: Fluorine is produced by electrolysis in a cell made of metallic magnesium. Carbon anodes are used with the metallic vessel serving as the cathode. The electrolyte, which is KHF_2 is kept at 100 deg. C. and is not dissipated since liquid HF is continuously fed into the cell and broken down into H_2 and F_2. The gases from the fluorine cell are passed through a coil immersed in dry ice (—80 deg. C.) to remove HF. The fluorine gas is then mixed with chlorine gas in proper proportions to have an excess of fluorine at all times. A blue flame results at the point of mixture. The gases are then passed through a U-tube which is heated to 280 deg. C. The ClF_3 thus obtained is condensed in a coil immersed in a —80 deg. C. bath and collected in iron cylinders. The cylinders are vented several times to allow HF, Cl, and F_2 to escape. The liquid ClF_3 is stable in such iron cylinders for long periods of time.

No fatal accidents occurred during the work on ClF_3 at Leverkusen. However, experience was obtained with effect of the material on the skin. Contact was immediately followed by a flash flame which did not in itself cause an appreciable burn. However, the resultant formation of HF at the surface of the skin produced a chemical burn. These were treated by washing with buttermilk and bandaging.

UNRETTED FLAX AND HEMP AS A TEXTILE FIBER

DURING the war, the Germans have had to use some linen in nearly every civilian fabric and in many military textile products as well because no cotton was available.

They had some retted flax and hemp fiber for their long fiber flax spinning system and utilized the short fibers or tow from these processes to the extent that such fibers were available. However, the great bulk of the bast fiber was obtained from the unretted straw or flax and hemp

NUMBER TWO OF A SERIES

ACTUAL TEST

The Job: To granulate discarded thermo-plastic rods, sheets and tubing for extrusion re-use.

The Equipment: Sprout-Waldron rotary knife cutter with specially protected hopper for manual feeding; knives and screens specified for granulating with a minimum of fines; heavy duty construction for anticipated shock loads due to wide variations in feed; and sheer pin safety hub to minimize danger of injury should tramp metal, etc., enter the unit.

The Result: Continuous, uniform granulation of cellulose acetate, vinylite and similar discards yielding an extrusion feed stock replacing 1/8" cubical pellets. Satisfied customer reports that output is several times that of competitive method . . . unit is safe in operation . . . economical . . . and readily cleaned when color change requires.

DIAGRAMMED THINKING . . .

ON THE REDUCTION TO THE GRANULAR STATE OF REJECTED THERMO-PLASTIC STOCKS

How does this apply to my problems?

1 **HOW ABOUT SYNTHETIC RUBBER?** Sprout-Waldron cutters are handling Koroseal with very satisfactory results. Successful test records also include Buna, Chemigum, Ameripol, natural rubber, tire tread, and even certain unvulcanized rubber stocks.

2 **WOULD *MY* SHEET STOCK FOUL A CUTTER?** If it does, a feeder is essential—probably a duplicate of an existing successful application, modified if necessary by a Sprout-Waldron Engineer.

3 **HOW ABOUT HEAT SENSITIVE MATERIAL?** This challenge has been met frequently through recommendations developed by the Sprout-Waldron Test Processing Laboratory.

4 **HOW ABOUT DEWATERED SHEETED COAGULATES?** Here a continuous uniform product of a size range suitable for the dryer is demanded, with fines kept to an absolute minimum . . . a TYPICAL APPLICATION for Sprout-Waldron facilities.

5 **WHAT ELSE CAN THIS UNIT GRANULATE?** Materials as dissimilar as silica gel, ion exchange resins, cork, vermiculite, pectin cake, leather, sheet glue, battery separators, sponge, cocoanut shells and tobacco stems, etc.

DIAGRAMMED THINKING means common sense analyzing before reaching a conclusion . . . the pick-it-up, study-it, cast-it-aside or adopt-it method. Study these actual mechanical preparation tests from Sprout-Waldron's file this analytical way . . . and write us to determine whether this equipment can be "adaptioneered" to solve your mechanical preparation problems!

The above actual test is typical—just one of many—processing jobs done by Sprout-Waldron equipment. Sprout-Waldron Equipment and Engineering Service is complete for size reduction, classification, mixing, blending, and MATERIALS HANDLING. *You* submit your mechanical preparation problem to us, we make the tests, and suggest what Sprout-Waldron equipment will best do the job! This gives you a COMPLETE PROCESSING SERVICE that is "LABOR AIDING—PROFIT PRODUCING." We invite you to submit your postwar problems to us now—address Department C.

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OF MUNCY, PA.
solve your mechanical preparation problems!

which was grown primarily for the seed from which the urgently needed linseed oil was obtained.

There is a considerable variation in both the mechanical and chemical treatments used but the object in all cases is to remove the "shives" or hard woody particles and to obtain a separation of the fibers into fiber bundles of the desired size. If the shives are not adequately removed, the yarn is of poor quality and the work does not run well in the mills. The smaller the bundle size the shorter the fibers, so if the fibers are separated to too great a degree, they are very short and the yarn made from such fibers is weak and uneven. Fibers which are too long, or not properly prepared, produce a poor quality of yarn.

Waste taken out runs from 40 to 65 percent of the fiber as received from the decorticating plant. After the flax or hemp plant is harvested by mowing machine, it is taken to the de-seeding plant where the seed is removed and the stalk is then run through the decorticating machine which is a mechanical flexing of the stalk such as would be obtained by coarse fluted rolls which breaks up the woody part and separates it from the fiber part. The fibers are then collected and dried in an oven after which they are shipped to the plant which is to prepare the fibers for the spinner. About 15 percent of the weight of the stalk is fiber.

The chemical process is for the purpose of retting. The object is to decompose the pectins and agglutinating substances so as to separate the fibers. There are two principal methods for chemically preparing unretted flax and hemp, one in most general use during the war, being the so-called alkali or caustic soda method which is less expensive than the second which is a combination of an alkaline treatment and a chlorination called the Korte process.

The alkaline process differs somewhat with the different plants. For instance, one plant wets out the fiber with circulating hot water for about a half hour then boils the fiber with a caustic soda solution for three hours, washes it in the kier and again washes it in a rack wool washer. After hydro-extracting the partly dried flax or hemp is then run through a hopper opener, after which it passes into a hot air dryer in which there is a low initial temperature which is gradually raised to a maximum of 70 deg. C. to keep the fibers from getting hard. Thereafter it is mechanically treated by a willow which serves to untangle the fiber and at the same time does some cleaning. From then it passes through several types of openers and finally through the Catonia or saw toothed surface cylinders where it is straightened and cut so that the final fiber is ready for the cotton spinner.

Another concern which grows its own hemp removes the seed, decorticates and dries the fiber which is then processed at the bleachery as follows: Without any mechanical pre-cleaning, the fiber is put directly into cold water, open vat with 5 g of hydrochloric acid per liter and steeped for 24 hr. After rinsing in cold water until free of acid, the fiber is then put into a closed kier where it is boiled at 2 atmospheres pressure for 4 hr. in a solution of

30 g. caustic soda per liter, next it is rinsed in a wool back washer, dried at 65 to 70 deg. C. and then the opening and cleaning operations begin. First it goes through a porcupine beater section, then through a single cylinder woolen card with coilers, the roving from which is cut into 40 mm. lengths, baled and shipped to cotton spinners.

In the Korte chlorinating process the fiber is usually given a preliminary alkaline boil, rinsed, then treated with a solution containing 2 g. per l. of HCl for 8 hr., for 2 to 3 hr. of which it must be circulated. Thereafter it is rinsed for 1 hr. and the mass of fibers pulled apart into small bunches to insure uniform circulation of the chlorinating bath which follows. Chlorinating bath liquor contains from 6 to 8 percent chlorine calculated on the weight of material. This chlorine liquor should circulate for 1 hr. so as to insure complete chlorination of all lignin and pectin matter still present in the flax or hemp in order that these substances may be completely soluble in the subsequent alkaline pressure boil. After rinsing to remove the chlorine and neutralizing with an alkaline sodium bisulphite solution the fiber is rinsed and packed into a kier in which the final chemical treatment is an alkaline pressure boil containing 9 g. of caustic soda and 2 g. of sodium sulphite per l., and this treatment continues from 6 to 8 hr. This dissolves the caustic soluble matter, requires 3 hr. of rinsing, first with hot then with cold water, after which the fiber is hydro-extracted and run through a porcupine beater section to separate the wet matted fiber into small bunches for the dryer. Thereafter the drying and mechanical operations are about the same as previously described.

BELGIAN CHEMICAL INDUSTRY

The German demands on the Belgian nitrogen and oxygen industries were for ammonia, concentrated nitric acid, liquid and gaseous oxygen, ammonium nitrate and ammonium chloride. Due to various production "diffculties" is was impossible to deliver any liquid oxygen, and only relatively small quantities of the other materials.

"Cobelaz" is a distributing syndicate representing the seven synthetic nitrogen producers and 21 producers of ammonia from coke-oven gases. In peacetime the production is used for fertilizers. Belgium normally has an excess capacity for ammonia, this excess being sent to France or to Holland (Sluiskil) and a corresponding quantity of NH_4NO_3 returned. The normal Belgian nitrogen production is 60,000 metric tons per year (pure nitrogen content). During the war the need increased to perhaps 90,000 tons per year. It was arranged that any excess NH_3 above 70,000 and up to 100,000 tons per yr. would be split 25 percent for Belgium and 75 percent for Germany. Production above 100,000 tons per yr. would be divided equally between Belgium and Germany. Germany would supply new pressure tank cars made in France. During the first year some 6,000 tons were sent to Germany but subsequent sabotage or manufacturing "difficulties" prevented the production of

3 WAYS to CONTROL TEMPERATURE

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1. FOR AIR-OPERATED SYSTEMS

A free floating air pilot valve actuated by the Pyrotron slidewire unit establishes an air loading pressure for the control of valves and drives. Adjustments and relays provide flexibility of range, sensitivity, and speed of response, as well as reset action, easy coordination with other factors, and remote manual control.

2. FOR ON-OFF ELECTRICAL SYSTEMS

By Electronic Relay—Two slidewires, one set manually to the desired temperature standard by a convenient knob and scale, and the other automatically positioned by the Pyrotron slidewire unit, form a control bridge which operates an electronic relay.

By Electric Contacts—Adjustable cam on Pyrotron slidewire unit operates a totally enclosed snap switch.

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A control bridge formed by two slidewires establishes a small signal voltage which changes in phase and intensity to operate a standard electronic control unit. The d-c output of this unit is accurately regulated according to the signal and applied to a saturable core reactor to vary voltage on the a-c heating circuit.

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ELECTRONIC RESISTANCE THERMOMETER

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2. Needs no careful leveling.
3. Motor drive provides abundant power for operation of recording pen, controller, alarms and signals.
4. Simple a-c measuring bridge needs no battery.
5. Sturdy electronic units keep the bridge in continuous balance and replace the usual galvanometer and its attendant mechanism for step by step balancing.
6. Interchangeability of packaged units simplifies replacement.

For details on this unusual Electronic Resistance Thermometer, which indicates, records and controls temperatures between —100°F. and 1200°F. ask for Bulletin 230-A. P-10

BAILEY METER COMPANY

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Controls for Processing

TEMPERATURE
PRESSURE
% OXYGEN
% COMBUSTIBLES

FLOW
LEVEL
DENSITY
RATIO

more than the 70,000 tons per yr. which Belgium retained and used almost entirely for fertilizers.

The Belgian explosive plant at Baelen was taken over by the firm of Meissner of Cologne, after which the Germans asked that concentrated HNO_3 be supplied. Cobelaz refused, because it was for explosives. Germany supplied all of the concentrated acid used at Baelen during the war. Cobelaz made a safe ammonium nitrate explosive for use in coal mines and quarries, using 50 percent nitric acid.

On November 6, 1943, they asked for oxygen stating that there was a lack of oxygen in Belgium for welding. It was proposed to install Linde equipment for the manufacture of liquid oxygen in three plants which had facilities for liquid air and refrigeration equipment in the form of liquefied gas plants (methane, etc., for automotive fuel). The three plants were those of Societe Carbochimique at Tertre, Ammoniaque Synthetique at Derives S.A. (Marly), at Willebrook, and Soc. Anonyme pour la Fabrication des Engrais Azotes Houdeng—Goegnies at Houdeng. The Linde equipment was to have been provided free of charge. The equipment arrived in January 1944 but was not assembled. In March or April the Germans demanded action, but the head of the three plants resigned. The equipment was then installed by Linde people but never operated.

The total capacity of the three oxygen plants was to have been equivalent to about 13,300 cubic metres air per hour. The liquid oxygen production would have been equivalent to about one sixth of this. In addition, there are seven plants outside Cobelaz making gaseous oxygen (L'Air Liquide (4), Oxyhydrique Int. (2), and S.A. Sogaz) with a total capacity of 9,000,000 cu. m. gaseous oxygen per year and a production of 6 8,000,000. About 9 percent of this was delivered to the Germans, the rest used for welding and cutting in Belgium.

In mid-August 1944 the Germans asked for the entire nitrogen production of three plants to be sent to Germany as ammonium nitrate. This would have amounted to 60 tons per day but was not shipped.

Starting in 1945 the Marly firm made ammonium chloride as demanded by the Germans, but the quality was poor. 1,200 tons per month was asked but only 3,200 tons total was delivered (for dry cells?).

The Germans demanded and received some quantities of coke-oven byproducts, sulphuric acid (66°Be), phthalic anhyride, smelter wastes containing arsenic and aluminum chloride. They demanded but received little or none of the following: maleic anhydride, calcium arsenate, hydrogen peroxide, nitric acid, alcohol, hydrofluoric acid, ethylene glycol, chloranine, triethanolamine, liquid oxygen, chlorsulfonic acid, sulfa drugs and potassium xanthate.

It was learned that the Belgians had a small mustard gas plant before the war, making ethylene from alcohol. This was disbanded at the outbreak of the war.

There is said to be no Fisher-Tropsch plant in Belgium. There was a Bergius process (coal liquefaction) pilot plant but this has not operated during the war.

CORROSION FORUM

EDMOND C. FETTER, Assistant Editor

MODERN MATERIALS • MODERN METALS

CORROSION REPORTER

In this discussion of materials of construction employed in the Rahway plant of Merck & Co., Inc., reference is made not only to a number of the ever-present heavy chemicals but also to several less common chemicals whose corrosive characteristics are not so widely known. As manufacturing chemists, Merck engages in the production of a very large number of very pure fine chemicals, many of them in small quantities.

This trio of factors—small amounts, great variety, and extreme purity—wields a profound influence in the choosing of materials of construction and results usually in the selection of materials far more resistant than would otherwise be necessary. Contamination of the product by materials of construction must be held to company specifications which are in some cases much more stringent than USP, NF, ACS and other recognized standards. Moreover, equipment to be used in processing small batches of a succession of different products cannot be built of the optimum material for each, but must be resistant enough to withstand all of them.

It seems important that these particular requirements which underlie Merck's choice of materials be kept in mind in the discussion which follows.

NITRIC ACID

Nitric acid is handled exclusively in stainless steel. The straight chrome type, although satisfactory for storage tanks, is not suitable for process equipment. For work at any temperature or concentration Type 316 (18-8Mo) and KA_2SMo are preferred. Vessels made of KA_2SMo have been exposed continuously to boiling nitric acid for 15 months without sign of corrosion.

HYDROCHLORIC ACID

Hydrochloric acid is a reagent in many reactions. HCl is stored in rubber-lined tanks. The reaction vessels in which it plays a part are always of glass-lined construction; agitators are also glass-enameled. In the more corrosive reactions, stuffing boxes with Hastelloy sleeves are used.

For HCl gas, steel is satisfactory if the gas is absolutely dry. Silver-coil and glass-lined condensers are generally used. Lead may be used even if there is a slight amount of moisture, though it suffers severe attack if the gas is moving at high velocity. To withstand wet gas or high velocities, porcelain, glass or glass-lined equipment is most acceptable.

Hard rubber and Saran piping have been used successfully at normal temperatures, but at high temperatures porcelain is the predominant piping material. Durichlor, Hastelloy, porcelain and hard-rubber pumps are used for cold acid. Tantalum is resistant to hot or cold acid, but fabrication difficulties limit its use. Ceramic ware is satisfactory for HCl, except that it is not very suitable for use with pure acid. Structural carbon is very highly regarded for use in heat exchangers.

ACETIC-HYDROBROMIC MIXTURE

A mixture of acetic and hydrobromic acids has presented unusually difficult problems. Except for tantalum, none of the familiar metals and alloys has adequate resistance. Tantalum has suitable corrosion resistance, and is used to a limited extent, as for example, in packing column supports. Hard rubber is not satisfactory. Of the many types of construction material investigated, the only ones to give good satisfaction from both the resistance and the fabrication stand-point are glass, porcelain, and glass-lined. Consequently, these materials, to the virtual exclusion of all others, are employed in all equipment throughout the system where this particular mixture occurs.

MISCELLANEOUS HALOGENS

It is fairly apparent that in processing halogen chemicals (with the emphatic exception of fluorine) glass, porcelain and glass-lined are the three main materials of construction. Others are frequently used for special, and often very limited, conditions but this use is more or less looked upon as a departure from standard procedure. These materials are specific for all equipment handling dry iodine or bromine, reaction vessels for production of hydrogen bromide by the reaction of hydrogen and bromine, equipment used to dry hydrogen bromide and hydrobromic acid, and for vessels used in the chlorination of alcohols. Although glass-lined vessels are the best we have for alcohol chlorination their service life is not good. The halides phosphorous trichloride, sulphuryl chloride and phosphorous oxychloride can be handled in lead or glass-lined vessels.

Alcoholic hydrobromic and alcoholic hydrochloric acids are handled only in glass-lined vessels using glass or hard rubber pumps and ceramic or porcelain cocks. No metals except tantalum are employed anywhere in contact with either acid.

SOLVENTS AND ORGANICS

Chlorinated solvents, although frequently handled by the industry in ordinary steel equipment, constitute a borderline case in point of corrosiveness and are just about corrosive enough to prevent plain steel from being called a satisfactory material. Stainless steel gives excellent performance, and while there is naturally a reluctance to employ a more expensive material if it can be avoided, there are many instances where it does not seem to pay to be closefisted. For example, valve trim should certainly be stainless, and even stainless storage tanks are economical when it is considered that their life is practically unlimited.

Certain organic esters, such as methyl acetate or ethyl formate, almost invariably require the use of glass for distillation operations. Most metals are unsuitable because they cause discoloration even though they themselves are not seriously corroded.

In processing acetic acid, stainless steel and aluminum are the two standbys and in most uses the two metals are interchangeable, choice being based upon such factors as cost, ease of fabrication, and availability. Aluminum is preferred for high-temperature work, as in stills and condensers, though as a valve material it has not proved very satisfactory.

NEWS BRIEFS

The Corrosion Forum, a newly organized society of Pittsburgh corrosionists, will meet January 14 to hear D. B. Williamson of Peoples Natural Gas Co., on "Corrosion of Pipelines." Though there is no connection between us, this department takes occasion, in passing, to extend best wishes to its namesake. Inquiries should be addressed to Richard Rimbach, 1131 Wolfendale St., Pittsburgh 12.

Five educational lectures on corrosion will be delivered as part of ASM's technical program in the National Metal Congress, Cleveland, Feb. 4-8. (See *Chem. & Met.*, November 1945, p. 234, for list of papers.)

The Corrosion Division of The Electrochemical Society will hold its annual meeting during the Society's national convention, Birmingham, Ala., April 10-13. One session of the general meeting will be sponsored by the Corrosion Division; details of this corrosion session will be announced later when the agenda has been established.

The 1946 annual convention of the National Assoc. of Corrosion Engineers will be held in Kansas City, Mo., May 7-9.

A new product, seamless tubing made of the recently developed 9-percent nickel steel, is being produced by The Babcock and Wilcox Tube Co., Beaver Falls, Pa. This is the first time that the high-nickel steel has been made available in tubular form.

Outstanding feature of the new alloy tubing is its ability to retain physical

properties at temperatures down to —320 deg. F. Developed primarily as pressure tubing for liquefied gases and other low temperature fluids, it is seen now as a substitute for 18-8 stainless in sub-zero work.

Although low-temperature applications are its forte, there are other possible uses which hinge on corrosion resistance and which appear to have promise. Among the latter are the following: Special pump tubing in oil wells where salt water and hydrogen sulphide are present, tubes for black liquor evaporation in the kraft paper industry, for evaporation of caustic solutions, and for work with alkaline phenol solutions.

Below are listed a number of German books on the subject of corrosion which have been reprinted under license of the U. S. Office of Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., publishers of foreign scientific books. Although the titles have been translated for this listing, the books themselves are in German. Copies may be obtained from Edwards Bros. at the prices indicated and should be ordered by number.

(91) "Corrosion of Metallic Materials." By Bauer, Krohnke, and Masing. 3 vol. (1936-1941): Vol. I, "Corrosion of Iron and Its Alloys," 560 pages, $13.65; Vol. II, "Corrosion of Non-Ferrous Metals and Alloys," 901 pages, $22.50; Vol. III, "Protection of Metallic Materials Against Corrosion," 615 pages, $14.50.

(92) "Decomposition Phenomena in Metals, An Introduction to Metallic Corrosion." By Gerhard Schikorr. 232 pages. $6.50 (1943).

(93) "Corrosion of Ferrous and Non-Ferrous Metals, Industrial Practice in Ships and Electric Power Plants." By August Siegel. 86 pages. $6.35 (1938).

(94) "Corrosion Tables of Metallic Materials, Arranged According to Corrosives." By Franz Ritter. 262 pages. $6.65 (1944).

(95) "Metallic Coatings." By Willy Machu. 643 pages. $15.50 (1943).

(96) "Synthetic Materials in Industrial Corrosion Control. A Handbook on *Vinidur* and *Oppanol*." By Walter L. Kraunich. 440 pages. $11.50 (1943).

LITERATURE REVIEW

Reactions of Aluminum and Magnesium with Certain Chlorinated Hydrocarbons. C. C. Clogston, Underwriters' Laboratories, Inc., Bulletin of Research No. 34, 16 pages, Aug. 1945:—Investigations of fire and explosion hazard show that aluminum powder in contact with certain chlorinated hydrocarbons is capable of explosive reaction; limited tests with magnesium powder indicated only slight reaction. Study did not include hazards, if any, in the use of aluminum or magnesium in massive form.

Cast Iron in the Chemical and Process Industries. F. L. LaQue for Gray Iron Founders' Society. 27 pages. Price $1:—Pamphlet discusses the economic and corrosion factors which have made cast iron "the most important material of construction in chemical engineering." Also includes 13-page compilation of corrosion data from plant and laboratory tests of plain and austenitic cast irons in many different chemicals; tables listing chemicals regularly handled by cast iron pumps and valves; table listing chemicals resisted satisfactorily by high silicon cast iron.

Deaeration by Elliott. Elliott Company, 20-page booklet, Nov. 1945:—Science of deaeration and its effectiveness in controlling corrosion of power plant equipment.

Chromate Corrosion Inhibitors for Internal Combustion Engines. Mutual Chemical Co. of America, Serial No. 33, 16-page bulletin:—Purpose is to show how chromates may be employed to the best advantage in various engine-cooling systems.

Symposium on Stress-Corrosion of Metals. Published jointly by AIME and ASTM. 500 pages. Price $5 to members of either society, $7.50 to nonmembers in U. S. A., $8 to nonmembers outside U. S. A.:—Book consists of the 30 papers presented at the jointly sponsored stress-corrosion symposium held in Philadelphia, November 1944. Represents the most extensive existing compilation of present-day knowledge on the resistance (or vulnerability) of metals to conditions of combined stress and corrosion.

Corrosion Resistant Masonry. The U. S. Stoneware Co., Bulletin 810, 51 pages:—Manual covering properties of materials, engineering data, design details, and construction aids.

Resistance of Nickel and Its Alloys to Corrosion by Caustic Alkalis. International Nickel Co., 20-page bulletin, June 1945:—Results of recent plant and laboratory tests on metal corrosion by caustic soda and other alkalis. Information is particularly pertinent to caustic manufacture and transportation, viscose rayon, soap, pulp and paper, petroleum refining, and other industries employing alkalis.

The Corrosion of Copper Evaporator Tubes. H. Inglesent and J. A. Storrow, *Journal* Society of Chemical Industry, Aug. 1945, pp. 233–236:—Examination of copper heating tubes from a triple-effect glucose evaporator to determine why old tubes were always corroded more at top than at bottom end. Conclusion was reached that—since liquor velocity increases as it moves up the tube, since corrosion occurred only on the liquor (inner) side, since there was no turbidity to cause errosion, and since reduction in wall thickness was progressively greater from bottom to top—the preferential attack could be attributed to the "motoelectric" effect. (When adjacent sections of a copper surface are in contact with a moving aqueous solution, the section subjected to the faster flow become anodic to the section in contact with the slower moving liquid.) Potential measurements on a model evaporator apparently confirm this explanation.

Cutting Stainless Steels by Torch Made Possible by New Equipment. *Blast Furnace and Steel Plant*, Aug. 1945, pp. 981, 983:—Description of Airco flux-injection method.

Heat and Corrosion Resistant Steels. R. W. Jones, *Steel Processing*, Aug. 1945, pp. 489–493:—Requirements imposed by various applications.

The Control of Oxidation on Zinc. Michael P. Bruno, *Modern Lithography*, June 1945, pp. 43, 45, 47, 49, 77:—Complete details on Cronak coating, including dipping technique, cost, and extent of usefulness.

Metal Corrosion by Water and Steam. W. Murray, *Chemical Trade Journal*, Aug. 31, 1945, pp. 247–249:—Causes and cures for corrosion in boilers and steam systems.

The Electrodeposition of Metals on Plastics. Harold Narcus, *Trans.* The Electrochemical Society, preprint 88-5, 1945, pp. 29–45.—Describes chemical-reduction method for rendering plastic surfaces conductive, and hence, electroplatable. Includes some data showing that, because of absence of galvanic couple between base metal and electrodeposited metal, corrosion resistance of the plating is greater when applied to a plastic than to a metal base.

Electrodeposition of Vinyl Plastics. Morris Feinleib, *Trans.* The Electrochemical Society, preprint 88-6, 1945, pp. 47–58:—Reports a research to determine the conditions under which electrophoretic deposition will take place and the factors affecting quality of deposit. Suggests applications for the process in the film casting, insulation, and protective coatings industries.

The Reaction of Copper and Oxygen-Saturated Ammonium Hydroxide. R. W. Lane and H. J. McDonald, *Corrosion and Material Protection*, Part I, Aug. 1945, pp. 17–24. Part II, Sept. 1945, pp. 15–18:—Reports an investigation to determine the best method for inhibiting the reaction of copper and ammonia by finding the rate-determining step in the reaction. (It is the copper-ammonia reaction which is instrumental in the corrosion of copper equipment in steam power plants which use nitrogenous surface waters as boiler feed.)

Tests on Iridite Finish for Cadmium and Zinc Plated Steel. K. E. Dorcas and N. H. Simpson, *Iron and Steel*, July 26, 1945, pp. 61, 143:—Favorable reports from independently made tests.

Corrosion Resistance of Clad 24S Aluminum Alloys. C. M. Marshall, *Automotive Industries*, July 1, 1945, pp. 28–29:—The effect (it was very little) of 500 hr. in salt spray and 48 hr. in an accelerated corrosion medium containing salt


JACOB RUPPERT

BREWERY

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Very truly yours,

JACOB RUPPERT

George E. Ruppert
President

and elongation of clad 24S, both aged and unaged.

Ferrous Piping Systems in Buildings. H. L. Shuldener, *Corrosion and Material Protection*, Aug. 1945, pp. 6, 8, 10–12:—Suggests some opportunities for lengthening service life through attention to factors of design, fabrication, and methods of operation.

Ethylcellulose Coatings Protect Metal Parts from Corrosion. F. L. Gerin, *Corrosion and Material Protection*, Aug. 1945, pp. 13–15:—Manner of application, characteristics, and future uses of ethylcellulose strip coatings.

Cleaning and Electroplate Finishing of Beryllium Copper Components. E. E. Halls, *Metal Treatment*, Summer 1945, pp. 71–85:—Techniques for cleaning beryllium copper without coroding it unduly.

Anti-Corrosive Painting of Metals. H. W. Rudd, *Paint Manufacture*, July 1945, pp. 183–188:—How to minimise corrosion under paint films on structural metals.

Passivation of Zinc Using Dichromate Base Solutions, with Special Reference to Electro-Zinc Deposits. E. E. Halls, *Metallurgia*, July 1945, pp. 99–104:—Results of experiments culminating in improvement of the efficiency (service/raw materials consumed) of the passivation treatment.

Corrosion Inhibitors. *Ind. and Eng. Chem., Ind. Ed.*, Aug. 1945, pp. 702–751 (the last-named paper is published in the Sept. issue, pp. 842–846):—A collection of the papers and discussions presented as part of the symposium on inhibitors at the 108th meeting of the American Chemical Society in New York. Comprised of the following:

Use of Soluble Inhibitors. U. R. Evans.
Zinc, Manganese, and Chromium Salts as Corrosion Inhibitors. R. S. Thornhill.
Threshold Treatment of Water Systems. G. B. Hatch and Owen Rice.
Protection of Small Water Systems from Corrosion. William Stericker.
Galvanic Corrosion of Steel Coupled to Nickel. H. R. Copson.
Scale and Corrosion Control in Potable Water Supplies at Army Camps. R. T. Hanlon, A. J. Steffen, G. A. Rohlich, and L. H. Kessler.
Inhibitors of Corrosion of Aluminum. G. G. Eldredge and R. B. Mears.
Chromate Corrosion Inhibitors in Bimetallic Systems. Marc Darrin.
Sodium Nitrite as Corrosion Inhibitor for Water. A. Wachter.
Corrosion Prevention by Controlled Calcium Carbonate Scale. S. T. Powell, H. E. Bacon, J. R. Lill.

Corrosion Control with Threshold Treatment. G. B. Hatch and Owen Rice, *Ind. and Eng. Chem., Ind. Ed.*, Aug. 1945, pp. 752–759:—Factors in formation of protective films upon steel by waters treated with glassy phosphates.

Aluminum in the Chemical Industry. J. L. Bray, *Aluminum and Magnesium*, July 1945, pp. 14–17, 25, 28–29:—Enumeration of applications; properties of the metal which make it useful.

Cathodic Protection on Distribution Systems. Ray M. Wainright, *Gas*, Sept. 1945, pp. 38–39:—Economics of cathodic protection in this use.

Preparing War Machines for Storage. G. W. Pressell, *Corrosion and Material Protection*, Sept. 1945, pp. 6–8:—Traces steps taken by various government agencies to draw up uniform specifications. Summarizes recommended procedure for preparing machine tools for storage.

Zinc Anodes for Preventing Corrosion of Distribution Mains. C. L. Morgan, *Petroleum Engineer*, Sept. 1945, pp. 196, 198, 200, 202, 205, 208:—Case history of the successful application of cathodic protection to steel gas mains in Houston, Tex.

Organic Coatings in the War Against Corrosion. Charles E. Erb, *Corrosion and Material Protection*, Sept. 1945, pp. 9–13:—States general principles governing use of synthetic organic coatings without going into detail on any particular resin or corrosive. Describes briefly some new developments in methods for cleaning metal surfaces, applying coatings and curing them.

The Acid Corrosion of Magnesium. G. E. Coates, Institute of Metals *Journal*, Sept. 1945, pp. 457–480:—Lengthy report of investigation into corrosion rate of magnesium in dilute acid. Measurements were made of corrosion rates, acid concentration, concentration polarization, and magnesium's potentials during corrosion. It was then attempted with fair success to set up the mathematical relationships, if any, by which corrosion rate could be expressed as a function of the other variables.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

WHEN THE JAPS threw the war into our lap, the little beet sugar factory at Holland, Mich., was closed and the neighborhood beets shipped elsewhere.

Good old Henry Hinze was the superintendent of this plant in 1900. During the three-month beet slicing campaign, the operators applied themselves with intensity day and night. Any interruption, however small, was a sin and abomination. On the first of October, Henry used to say goodbye to his family and take his nightshirt to the factory. At low twelve he could be found roaming around in his bed slippers in front of the carbonators checking up on alkalinity.

Recently the chronicler had a desire to revisit the Holland factory and besought a passing newsboy for road directions to the "Sugar House." The kid snapped back, "That aint no sugar house. It's a doughnut mill." The plant had in fact been leased to the Doughnut Corp. of America. Their business is to prepare a doughnut mix and furnish the machines for doughnut production to the public. It is a nationwide outfit milling in one of its eastern plants 2,000 bbl. of flour daily for the exploitation of the American dunker. The cut in the sugar supply threatened loss of business and so the company, under the leadership of Jim Walsh, tailored a process to fit the idle beet sugar house for producing dextrose out of wheat flour. Nearly every important piece of equipment is used except the lime kiln and the diffusion battery with its accessories.

An ingenious mixer prepares a thin flour slurry at a definite density and temperature under which the starch precipitates and the protein agglomerates and rises to the surface. By means of a vibrating wet screen ("jitterbug") the protein is separated, successively re-screened twice for washing, and then dried in the beet pulp dryers with steam. The resulting protein of 85 percent purity is sold for cattle feed and for meat extenders, since its qualities are comparable to those of meat.

The starch is hydrolized with HCl in wooden tubs installed in the warehouse whence it is delivered into the old carbonators, now used as receiving tanks. The syrup thereafter follows a path almost parallel to the beet juice. Kieselguhr and activated carbon are added to the hydrolized flour syrup in the carbonators, and the liquor then passes respectively through plate-and-frame filter presses and through the quadruple effect evaporators where it is concentrated to 30 deg. Be. The thick juice is filtered a second time with kieselguhr and carbon and then sent to the pan storage tanks. In the vacuum pan the liquor is concentrated to 38.8 deg. Be and then cooled by the effect of high vacuum to 48 deg. C.

This syrup is discharged onto a footing of crystallized dextrose for seed. The seeded syrup is charged into the old water-jacketed crystallizers where the cooling requires a cycle of 4½ days. A modern crystallizer could reduce this time by half. The crystals are then separated by means of the old centrifugals (25-min. cycle) and dried in the "granulator." The syrup is refined for ice cream sweetening and for stock feed. The dextrose substitutes for sucrose at a sweetening effect of about 70 percent and is shipped to the blending plants where the mix is made.

An unusual thing is the use of undried carbon arriving in bulk in box cars. It contains about 85 percent moisture and thus avoids the discomfort that accompanies the discharge of dry impalpable dust from bags. For convenience in handling, the carbon and kieselguhr are mixed into a slurry. The waste press cake is believed to be able to add value to the sludge of the city's sewerage treatment works and a study is now in progress to establish this premise.

CHEMISTS POSSESS a certain resourcefulness in the application of hokus-pokus. Our Doc was refused a ticket for himself and his wife on an American-bound plane in Havana last spring for lack of a priority. After a little dignified hesitation he flashed his celophane "Coast Guard Identification Card" issued at Philadelphia. The agent could not read the fine print but he was impressed with "Captain of the Port" emblazoned across the top just above Doc's photograph. With a bow and obsequiousness, the agent promptly commandeered for the important U. S. official two tickets previously assigned to a common butter-and-egg man from New York credited statistically at a paltry five million.

GEORGE KLINE, classmate Nebraska '00 and now editor emeritus of the "Star," was prominent in politics, especially in the movement which brought about the unicameral legislature for Nebraska. During a recent visit, the chronicler accused George of the "murder" of John Ledwith during one of his college pranks. He said that since the statute of limitations had run against the deed, he could now safely admit it, but that it was accomplished with the cooperation of John himself.

The facts, as they appeared in large print on the front page of the evening paper, were that John had vanished without trace. His room was disheveled; all of his clothing and his shoes were accounted for, but one bed sheet was missing. Smears of blood were found on the windowsill, implying the manner of exit. There was evidence of a struggle and all the gruesome details were set forth in the papers. The Lincoln detective force promptly got on the job and searched for the possible woman in the case. Next day the mystery was solved. John had gotten a new outfit of clothing from hat to shoes in order to be properly attired to visit his folks in Omaha. The conspirators then arranged the circumstances of a perfect crime, complete to blood donated by a rabbit. The purpose, i.e., to break the monotony of the midwinter session, had been accomplished.

A SUGAR WAREHOUSE in Rocky Ford, Colo., was visited by a fire according to the log dated January 1906. Smoke slightly penetrated the outside tiers of a stack of 32,000 100-lb. bags but the core was not damaged. The minds of the insurance carriers and the sugar company could not meet as to the amount of damage. Accordingly the insurance company bought the sugar and shipped it to Chicago where the market was beginning to absorb it. Then by accident a rumor spread about the fire and so the wholesalers refused to handle the sugar. Thereupon the insurance company shipped it back to Colorado and sold it to the housewives. There were no defects in the sugar but, through no fault of its own, its reputation had been smeared.

ALBERT ROOF, as a green grad, became attached to Joe Eckert's laboratory at the Ottawa, Ohio, sugar house. Albert made no great impression as a chemist. He was no wizard in the art though he exhibited faithfulness and energy.

One day as he was strolling near the golf course he retrieved a ball and handed it to its owner. A pleasant conversation followed, the player being an official of the Republic Steel Co. A few years later Albert was on the Republic sales staff at an annual honorarium of $8,000. Not long thereafter he transfered to another concern as a salesman at double the salary. His college had tried to make a chemist out of salesman material and failed. Liquorwise Albert is as dry as the Sahara, a circumstance once thought to be incompatible with salesmanship.

LAST SUMMER Joe received an application from a candidate for an opening in his laboratory. Joe requested further details. The chemist answered that if he had any ability he wouldn't be applying for a job in a sugar house laboratory. In fact the very act marked him as a man of mediocre quality! No brilliant or out-

standing achievement could be expected from him! The laboratory might be cluttered up with the instruments of the learned men of science but the fundamental processes pioneered in France 150 years ago would continue unaffected. On the other hand, as a control chemist, he was equipped with a sensitive nose. "Yessir, a fellow with a good sniffer can soon tell what's going on, whether it's in a sugar factory, a glue works or any other chemical plant where the reactions are accompanied by aromatic emanations."

OLD PHILLIP, the man of all work, in 1936 reminisced that about twenty years earlier he had lost his wife. All of his children were now married and there was a flock of grandchildren. He now gave some thought to remarrying to dispel the lonesomeness. The preliminary arrangements had in fact been completed with a young woman the age of his son. However Phillip hit a snag. He explained that "nowadays" women who marry widowers demand an advance settlement. From the lady's point of view, the "old crab" wanted a housekeeper for the bare price of maintenance.

ALEX SPENT an occasional Saturday afternoon inspecting the progress of the construction of his new house on Long Island. Adventitiously one Saturday the city building inspector was making his official rounds. He called Alex's attention to a "violation" in the construction of the chimney which exposed the house to a fire hazard. The next day Alex passed the information to the contractor. Said contractor replied reassuringly, "Don't worry. I'll fix it up with the inspector."

VISITORS REMARK the smoothness of plant operation in industrial plants. The thing seems entirely automatic. The faithful sergeants like foreman Eckstein anticipate, think, and maintain. In '41 the log records that right after New Year's day Eckstein and the "little woman" departed for Florida to visit relatives, leaving his address for emergency. He had not found it convenient in recent years to take a vacation and so he had an accumulation of sabbatical time to his credit. On Saturday morning, three weeks later, he returned to his home on the Jersey side of the Delaware. His first act was to 'phone the works to inquire how we were faring. The answer did not satisfy him and so he came down to the plant for an inspection. He spent most of the afternoon looking around, while his wife sat in the car out front. During his sojourn in Florida the Chronicler wrote him several letters. His wife reported that if these had not arrived, she could not have held him for three weeks.

THE WIFE OF OLD JOHN, engine room foreman, proudly displayed the college classbook which had been dedicated to son John. The chronicler ventured that he had heard that son John had developed outstanding skill as an occulist. "Opthalmologist," she snapped, "the highest of all medical professions." Then she explained that she had raised John with her own hands. On the other hand, a second son, Jim, had quit college and was now driving a truck. Shame on him! She panned her husband severely for allowing Jim to take the truck job while she lay helpless in bed. The chronicler suggested to her that God needs a diversity of men, even truck drivers. Jim's honorarium actually exceeded John's and he may some day acquire ownership of the business.

"Serendipity" seldom gets out of Webster's unabridged, although it represents a practice not unused by engineers. The colored parson who is forever forgetting his references, urges its practice on the brethern. He exhorts them to make search in the Book for his text with the promise that if they fail to find it, they will be rewarded with other nuggets of value.

AS A BYPRODUCT to his regular duties in a Southern California distillery, Doc evolved some yeast feed and supplied a stock feeder with a pilot size sample for biological analysis. The feeder segregated two groups of ten steers, one to be fed on Doc's feed and the other on a flax meal. Doc's group exceeded the others but the margin was small and the advantage as to the cost per pound of beef was against him. Doc did not believe it. So he gumshoed to the feeding pen by the dark of the moon and learned that the tender, presumably under the motive of a subsidy, had added a portion of Doc's yeast to the flax meal without reflecting the facts in the cost account. Doc's chemical reaction is not of record.

A WIRE from Al Grevemberg of the Savannah refinery announced a date when he would visit our plant. A sugar tramp does not ask for an invitation and of course we could not stop him, but we fixed the price of welcome at the front door at two one-pound sample cartons of his famous "Dixie" soft sugar for comparison with our own. Al travels light. He did not relish lugging two extra pounds of dunnage. Accordingly he inserted two knocked-down cartons with his night shirt in the brief case and, upon arrival in Philadelphia, he filled them with our soft sugar purchased from a local grocer. Murder will out. Al excused himself by claiming that chemist Bob Stokes evolved the suggestion.

OILER BILL JENKINS ambitions inclined toward the art of sheet metal fabrication and at every opportunity he feasted his eyes on the craftsmanship of master artisan Charlie Kelley. Charlie esteemed his job as the most exalted of crafts and himself as the topmost practitioner of his art. One morning Bill was intently watching Charlie perform on an emergency job that had kept him up all night. Suddenly Bill blurted out, "Kelley does a fellow have to know much to be a tinner?" Bill found it expedient to make a quick retreat to escape Charlie's murderous temper, but he eventually attained his ambition "What one fool can do another can."

PARSON'S CONTRIBUTION to packing efficiency is an automatic scale of superior quality. He has restricted his activity to his California neighborhood. His customers are his friends and he makes

A $23,000,000 LOAD

carried by PRESSURE CREOSOTED piles

Test loads of 25 to 30 tons were applied to piles in refinery foundation

The engineers had some real foundation problems to lick, when a complete $23,000,000 plant for producing 100-octane gas was constructed on the Gulf Coast.

Layers of clay near the surface are underlaid with deposits of sand, and soil exploration showed wide variation in character and supporting value. Dead loads were heavy, and in addition wind loads resulting from velocities up to 125 miles an hour, on structures up to 20-stories high, had to be considered.

In the areas where concrete mats could not provide sufficient stability, the engineers used pressure-creosoted southern yellow pine piles. Lengths ranged from 35 to 45 feet, and treatment was by an empty-cell process to a final retention of 12-lbs. of coal-tar creosote per cubic foot of wood.

A few of the foundation piles for storage tank at water front

As often happens in soils like this, the dynamic driving formulae did not give a true index of the supporting value of piles. In the test illustrated, piles that showed only 5 and 6 tons respectively by the hammer formulae were loaded to 25 and 30 tons without a single indication of failure. After unloading, the net settlement was found to be negligible.

We are equipped to treat piling in any length up to 125-ft., and will be glad to quote promptly on your requirements.

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frequent rounds to keep a jealous watch over his installations. Jack Hebert once asked him why he did not extend his territory so as to spread the benefits of his talents. His answer was that he could eat only three meals a day.

THE LATE JOSEPH MAUDRU, chemical wizard of the Great Western and sugar tramp extraordinary, arrived at the Fort Collins, Colo., factory about 1904 when the processes were crudely practiced. Chemists and operators groped for information with rivalry. When a disturbance arose which the operators were unable to fathom, they relieved their minds by declaring that it "musta been the chemist." Joe's first job at Fort Collins was to search out the mystery of a sugar leak to the condensate that shut down the steam plant. All he had besides his propensity for research was a lantern and a polariscope but he found the leak. He recalled a natural mechanic who forsook his father's farm in Utah and became an operator at the Lehi, Utah, factory in 1894. Through his mechanical ingenuity the farmer grew into a famous manufacturer of centrifugals, pioneering in the application of high speed. He referred to his development as the "quick pick-up." As progress continued he followed the trend and added an expert research chemist to his staff. The chemist dug up a term of Latin derivation and called it "rapid acceleration." Presto, the manufacturer added $1,000 to the price of his machine.

THE RAW FOOD ADDICT, who insists that nature knows best, demands his sugar in the raw. He acclaims the virtues of blackstrap which is the end product of the sugar refinery, containing the accumulation of things which the refiner removes to secure purity and whiteness in his product. Paul De Vries, of Revere, in his efforts to serve (i. e. of course, the profit motive!) proposes to convert the blackstrap into a dry meal by means of a spray dryer. He avers that the stuff has a repulsive taste but palatability can be improved by glamorizing the package. Anything, says Paul, will sell if the word "grandmother" is somehow twined into the trademark.

DOC'S CHEMICAL MINDEDNESS cannot reconcile the logic of his dirt farmer tenant in respect to the quality of his dairy herd.* The tenant favors the herd of 42 scrub cows in preference to 29 pedigreed cows of equal milk output on the grounds that the more numerous herd produces more byproduct fertilizer for his acres. This in spite of published statistics to wit: A good cow is efficient and converts the digestible nutrients into milk while a scrub grows fat. A good cow begets good calves. A cow producing 4,500 lb. of milk annually requires 11.4 lb. of digestible nutrients daily while a production of 8,600 lb. of milk requires 15.4 lb. of digestible nutrients. "A cow eats personal property and excretes real estate." Doc's tenant feeds hay at $20 per ton plus grain at $40 to manufacture manure worth $8 per ton.

* See *Chem. & Met.* May 1944, p. 179.

NAMES IN THE NEWS

A. H. Waitt

M. Brugler

R. G. Follis

Alden H. Waitt, brigadier general, CWS, USA, has been appointed assistant chief director of research and development, for the Chemical Warfare Service.

Louis B. Howard has been named assistant chief of the department of agriculture, Bureau of Agricultural and Industrial Chemistry, where he will participate with the chief of the bureau in the planning and administration of research and development activities, which include the four regional research laboratories.

Joseph A. Noone, chief chemist of the Greenwich works of the Pennsylvania Salt Mfg. Co., has been transferred to the company's executive offices in Philadelphia where he will handle labeling and regulatory matters in connection with the company's products.

G. S. Myers has been appointed a member of the chemical engineering staff of Eshelman & Potter, combustion and chemical engineers, of Birmingham and Charlotte, N. C. Mr. Myers, a graduate of Georgia Institute of Technology, was formerly with TVA.

Maurice du Pont Lee, manager of the rayon technical division since 1932, has been named general consultant in the engineering department of E. I. du Pont de Nemours & Co.

George L. Wesp has joined the central research laboratories of Monsanto Chemical Co., Dayton. Dr. Wesp was formerly employed in the research laboratory of Curtiss-Wright.

R. Wayne Gates has joined the Pemco Corp. research and development staff.

Richard B. Kropf, formerly district manager of the Copperweld Steel Co., has joined the International Nickel Co., where he will be in charge of the newly established Cincinnati Chemical Section of the Development and Research Division.

Mercer Brugler, a vice-president and general manager since 1939, has been named president of the Pfaudler Co. to succeed **W. D. Pheteplace,** who has retired.

E. V. Crane has been made vice-president of Sam Tour & Co., where he will be in charge of chemical engineering and metalworking projects and research.

Charles H. Gant has been appointed manager of Hercules Powder Co.'s Parlin, N. J., plant. He succeeded **Edward G. Crum** who has been made assistant general manager of the cellulose products department of Hercules in Wilmington.

Harold C. Foust, who has been a research associate at the University of Virginia, is the first holder of the fellowship in chemical engineering at Princeton University, established by the Celanese Corp. of America. The fellowship in organic chemistry recently founded by Standard Brands, Inc., has been awarded to **Robert T. Anderson,** who has been a research chemist in the laboratory of Merck & Co.

Arthur E. Gibbs, advisory technical director of the Pennsylvania Salt Mfg. Co., and the firm's first director of research, has retired to return to his home in England.

E. L. Gaudin has been named vice-president of the Herbert Chemical Co. He has been Cincinnati representative of the Mathieson Alkali Works for the last 18 years.

J. T. Rettaliata, who recently accepted the post of director of the mechanical engineering department at the Illinois Institute of Technology, will continue his association with Allis-Chalmers as consultant on gas turbine development and similar problems.

Alan B. Olsen has been named vice-president and general manager of the Wright Carbon Co., Cleveland.

R. G. Follis has recently been elected president of Standard Oil of California. At the same time, **H. D. Collier** was elevated to chairmanship of the board of directors. Mr. Follis, a vice president and director of the firm since 1942, first worked for Standard of California in 1924 at the Richmond refinery. In 1940 he was made general manager of the manufacturing department.

Clifford G. Reynolds has been named technical director of the Empire, Ore., and Anacortes, Wash., plants of the Coos Bay Pulp Corp.

Samuel G. Baker has been named assistant general manager of the Electrochemicals Department of E. I. du Pont de Nemours & Co., and **Milton Kutz,** who had been acting as assistant general manager, has been made special assistant to the general manager.

Thomas E. Moffitt, for many years associated with the chemical industries of the Pacific Northwest through Hooker Electrochemical Co., has joined the Weyerhauser Timber Co., Tacoma, Wash., as production and marketing manager of new products developed by the firm's research and development department at Longview, Wash.

E. W. Daniels, president of Harbor Plywood Corp., Hoquiam, Wash., has been elected president of the board of trustees of the recently-organized Plywood Research Foundation.

Philip E. Rice has been appointed manager of the synthetic rubber plant operated by the United States Rubber Co. at Los Angeles. Mr. Rice was for many years superintendent of the company's Naugatuck Chemical Division in Connecticut and in 1941 he became factory manager of chemicals, reclaimed and synthetic rubber at the Nugatuck plant.

Paul D. Zottu, formerly chief engineer, Thermex Division of the Girdler Corp.,

Louisville, has established a consulting service in the field of high frequency induction and dielectric heating, specializing in applications, equipment and component design and equipment selection.

Louis S. Cates, president of Phelps-Dodge Corp., has been elected president of the American Institute of Mining and Metallurgical Engineers for 1946.

Fred G. Thedieck, manager of the Chickasaw Ordnance Works, E. I. du Pont de Nemours & Co., has been appointed manager of the Wabash River Ordnance Works, Terre Haute, Ind. **Dugald M. Carr,** assistant manager at Chickasaw, will remain in that capacity in charge of the plant.

Milo N. Mickelson has joined the staff of the Midwest Research Institute, Kansas City. Dr. Mickelson was formerly professor of bacteriology and bio-chemistry at the University of Michigan.

Gordon W. McBride has resigned from his position as principal chemical engineer in the Agricultural Research Administration of the U. S. Department of Agriculture. He has resumed consulting practice in association with Russell S. McBride, and will also assist on the editorial problems of *Chem. & Met.* in Washington.

Ross W. Thomas has been appointed manager of research and development for Phillips Petroleum Co. He will be executive assistant to G. G. Oberfell. **G. R. Benz** succeeds Mr. Thomas as manager of the chemical products department.

Anthony M. Schwartz is now a member of the staff of Milton Harris Associates, Washington, D. C. Dr. Schwartz was formerly director of research of the Alrose Chemical Co. and in his new connection will conduct work in the field of organic synthesis.

Roger Adams, head of the department of chemistry, University of Illinois, has been appointed special advisor to Lt.-Gen. Lucius DuB. Clay, deputy military governor of Germany, and U. S. deputy member of the Allied Group Control Council in Berlin.

Stephen F. Urban has been made director of research in charge of all divisions of the research laboratories of the Titanium Alloy Mfg. Co., Niagara Falls. These include metallurgical, ceramic and chemical. **Eugene Wainer,** formerly in charge of the chemical and ceramic divisions, has been made associate director of research, and **William Baldwin** has been made chief of the ceramic division.

Floyd L. Boddicker, former manager of the Hercules-operated Sunflower Ordnance Works, has been appointed manager of cellulose products operations at the Hercules Powder Co., Hopewell, Va., plant. He succeeds **Clark B. Kingery,** who has been appointed assistant director of personnel for the company.

Burt P. Johnson has joined the research staff of the Institute of Textile Technol-

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HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

ogy, Charlottesville, Va., as head of the biology division.

Jack Turer, formerly with the Eastern Regional Research Laboratory, Wyndmoor, Pa., has joined the staff of the research laboratories, Virginia-Carolina Chemical Corp., Carteret, N. J., where he will be engaged in organic research.

Daniel Frishman, recently released from the Manhattan Project, Oak Ridge, Tenn., has joined the staff of Milton Harris Associates, Washington, D. C., where he will conduct work on wool chemistry and related problems.

Wendell M. Stanley, biochemist of the Rockefeller Institute for Medical Research at Princeton, N. J., has been awarded the William H. Nichols Medal of the New York Section of the American Chemical Society. Presentation of the medal will be made on March 8 at a joint meeting of the Chemical Society's New York Section and the Society of Chemical Industry in New York. Dr. Stanley is a graduate of the University of Illinois.

George De Witt Graves and **Robert Emmett Burk** have been appointed assistant chemical directors of the plastics department of E. I. du Pont de Nemours & Co. Dr. Graves joined the Du Pont Co. in 1927 and entered the plastics department last January. Dr. Burk joined the plastics department in September, 1944. Both men are filling newly created posts and will be stationed in Wilmington.

John H. Lutz has joined the Sharples Corp. as engineer with the overseas division, working on centrifugal processes. He was division head of packaging research, General Foods Corp.

K. G. Baker has returned to Wagner Electric Corp., Indianapolis, as a field engineer, after three years' active duty with the Army.

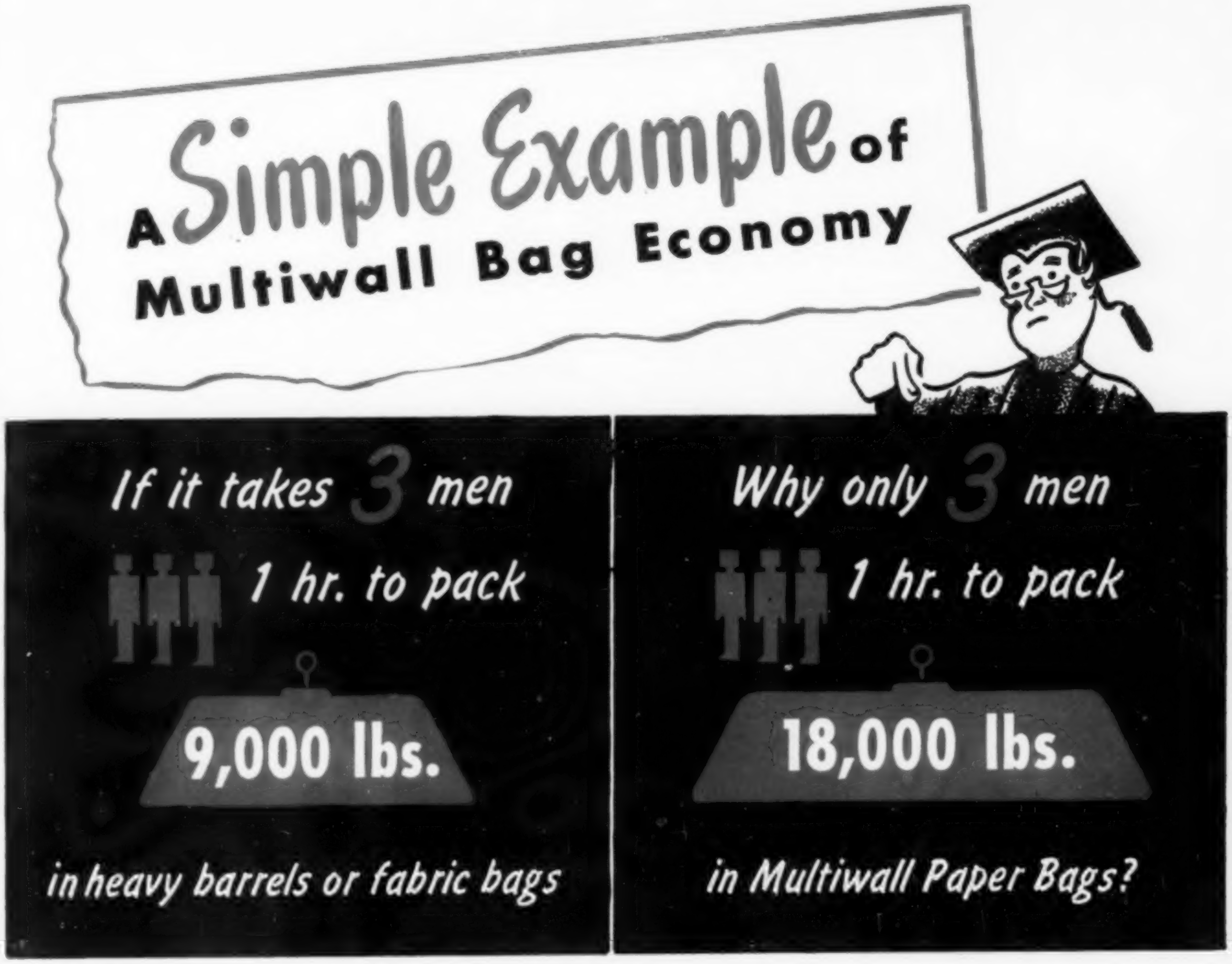
John M. Parks has joined the staff of the American Society for Metals as editor of technical books. Dr. Parks is a chemical engineering graduate of Purdue University.

Zay Jeffries, vice-president of the General Electric Co. in charge of its chemical department at Pittsfield, Mass., and past president of the American Institute of Mining & Metallurgical Engineers, has been awarded the 1946 John Fritz Medal.

Richard H. Westfall has joined the staff of Westvaco Chlorine Products Corp. as a research engineer in the South Charleston, W. Va., division. A graduate of the University of Kansas, Mr. Westfall had been with Hercules Powder Co. before joining Westvaco.

F. S. Norcross, Jr., has been elected a vice-president of Freeport Sulphur Co. Mr. Norcross is president and general manager of Freeport's manganese mining subsidiary.

G. M. Schroder has joined the staff of the Industrial Research Institute at the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If it takes 3 men
1 hr. to pack
9,000 lbs.
in heavy barrels or fabric bags
Why only 3 men
1 hr. to pack
18,000 lbs.
in Multiwall Paper Bags?

University of Chattanooga. Prior to the war, Mr. Schroder was employed as research chemist by the American Tobacco Co., Richmond, Va.

Milton Gallagher has joined the staff of the Industrial Research Institute of the University of Chattanooga. Dr. Gallagher was formerly associated with Owens-Corning Fiberglas Corp. and the Tennessee Eastman Corp.

A. R. Hauser has been named to succeed the late **John McClain** as joint district manager of Clark Bros. Co. and Pacific Pumps, Inc., at the Chicago offices. Mr. Hauser comes to his new duties after ten years in the engineering department of Pacific Pumps, Huntington Park, Calif. During his last three years with Pacific Pumps he was assistant chief engineer. In Chicago he will represent both companies.

Avery Van Campen, who for the past ten years has been employed by Clark Bros. Co., Inc., in their experimental, engineering and sales departments, has been appointed to their New York sales office in the capacity of district engineer.

Raymond Reuter recently left PAW and is now with the Chicago Chemical Co. at Chicago.

Lynn Sawyer, general manager of the pump division of the Byron Jackson Co., was elected a vice president of the company.

Charles H. Herty, Jr., of Bethlehem, Pa., was elected national president of the American Society for Metals at the annual meeting held in Cleveland last month.

William T. Griffiths, of London, has been elected a vice president and director of the International Nickel Co. of Canada, Ltd., to succeed the late **David Owen Evans**.

John Sheppard has been appointed metallurgical technical service representative to the metal trades in Detroit by American Cyanamid & Chemical Corp.

Victor R. Farlow has joined American Cyanamid & Chemical Corp. as technical service representative. He will be a member of the Chicago district office.

Clark B. Kingery has been appointed assistant director of personnel of Hercules Powder Co.

William W. Coffeen, a graduate of the University of Illinois, has joined the Ceramic research staff of Metal & Thermit Corp., Carteret, N. J.

Peter Kaye has rejoined the Canadian Research Institute, Toronto, as associate director, after service in the Canadian Army.

Weston G. Frome has been appointed general manager of the explosives department of Atlas Powder Co., succeeding **F. S. Pollock**, vice-president, who was

make it white or make it colorful . . .

to make it sell!

America is going shopping again for the thousand-and-one articles wanted and needed to replenish its war depleted larder. And brilliantly colored or dazzlingly white merchandise of many kinds will make the cash register ring most often.

To make articles dazzlingly white or brilliantly colorful, bleaching is of fundamental importance to many industries. Mathieson, pioneer developer of bleaching chemicals including chlorine, calcium hypochlorites and Sodium Chlorite, has a primary and functional interest in assisting you with your bleaching.

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PIONEERS AND LEADERS IN THE MANUFACTURE OF CHEMICAL BLEACHING AGENTS

elected member of the executive committee.

John W. Mayers, formerly with Monsanto Chemical Co., has been appointed to direct the research and development program to be undertaken for the Chadeloid Corp.

Charles O. Persing has joined the Agricultural Research Staff, Pacific Coast Division of the Stauffer Chemical Co. Dr. Persing will be located in the company's research laboratory in Richmond, Calif.

Hendley N. Blackmon has resigned as manager of editorial service of Westinghouse Electric Corp. to join the McGraw-Hill Publishing Co. as electrical editor of *Product Engineering*. Pending the return of **Carl Nagel,** now on duty with the U. S. Navy, **H. C. McDaniel** will act as supervisor of editorial service at Westinghouse and will be responsible for the company's technical and trade magazine publicity activities.

John C. Moessinger, a chemist with General Aniline & Film Corp. since 1921, has been appointed manager of the process development department at the Rensselaer plant of the company.

Fred Searls, Jr., vice-president of Newmont Mining Corp., has been awarded the William Lawrence Saunders Gold Medal for 1946 by the AIME. Presentation will take place in Chicago in February.

W. W. Hodge, formerly professor of chemical engineering and head of the chemical engineering department of West Virginia University, has been appointed senior fellow and director of the council's Multiple Research Fellowship of the National Council for Stream Improvement at the Mellon Institute, Pittsburgh.

Marvin E. Thorner, until recently a lieutenant in the Navy, and formerly with Standard Oil Co. of N. J., is now production manager at U. & J. Lenson Corp. in Brooklyn.

William I. Harber has joined the staff of Bjorksten Laboratories, Chicago, as the senior organic chemist.

J. F. M. Taylor, until recently with Shell Oil Co. in New York as vice president of manufacturing, has opened offices as a private consultant at 1155 Lokoya Road, Napa, Calif.

OBITUARIES

Frank C. Angle, 45, manager of the general machinery division field sales offices, Allis-Chalmers Mfg. Co., Milwaukee, died October 25.

Norman B. Siebenthaler, 58, widely known mechanical engineer, died at his home in Dayton November 12.

C. Tennant Lee, 69, died in San Diego, Calif., November 22.

INDUSTRIAL NOTES

United Steel of America, New York, has elected Evan V. Quinn vice president and sales manager. Mr. Quinn formerly was with Edge Moor Iron Works and prior to that was sales engineer for Struther Wells Co.

General Electric Co., Pittsfield, Mass., has placed J. G. Short, Jr., in charge of the Atlantic district of the chemical department with headquarters in Philadelphia. N. A. Freuden has been named sales manager of molded products of the plastics division with headquarters in Pittsfield. Both appointments are effective January 1.

Cochrane Chemical Co., Jersey City, announces that it has moved its sales and executive offices to 180 Blanchard St., Newark and requests that all communications be sent to the new address.

Orefraction, Inc., Pittsburgh, has elected Jack Hunt vice president and general manager to supervise the manufacture and sales promotion of zircon, rutile, and ilmenite. Mr. Hunt formerly was with Titanium Alloy Mfg. Co. as field development engineer.

Fairbanks, Morse & Co., Chicago, has advanced Charles H. Morse, Third, to the position of vice president in charge of research, patents, traffic, the company's western pump division, and the Inland Utilities Co. He is the son of Col. Robert H. Morse, president, and a brother of Robert H. Morse, Jr., vice president and general sales manager.

Allis-Chalmers, Milwaukee, has transferred G. V. Woody from Pittsburgh, where he served as manager of the district office, to Milwaukee to succeed R. C. Newhouse as manager of the basic industries department. Mr. Newhouse has retired after 40 years service with the company but will be retained as a consultant.

W. S. Rockwell Co., New York, will retain a sales engineering office at 50 Church St. but general headquarters have been moved to 200 Eliot St., Fairfield, Conn. where activities of the furnace division, the valve division, and the Gehnrich division will be consolidated.

Gyretech Corp., Chicago, was recently formed to specialize in precision metal spinning and its plant at 2734 Janssen Ave., is now in operation. R. H. Altman is general manager and Royal Bonner is plant superintendent.

Joy Mfg. Co., Pittsburgh, has completed an agreement for the acquisition of La-Del Conveyor & Mfg. of New Philadelphia, Ohio. Operations will continue at the present plant site but the company name later will be changed to the La-Del division of Joy.

King Engineering Corp., Ann Arbor, Mich., has assigned King-Gage sales in northeastern Ohio to G. D. Carnegie who will establish the King Instrument Co. at 13229 West Ave., Cleveland.

Wyandotte Chemicals Corp., Wyandotte, Mich., will open a new Michigan Alkali division office in Pittsburgh in the P. & L. E. Terminal Annex Bldg. M. J. Conway formerly of New York will manage the new office.

John A. Roebling's Sons Co., Trenton, N. J., has moved Firman G. Hoyt from Los Angeles to Trenton where he will act as product sales manager of the woven wire fabrics division. He succeeds W. K. Paff who has retired after 50 years service with the company.

The Protectoseal Co., Chicago, has appointed John W. Mock sales manager. He will have charge of distribution of the company's complete line of safety devices for handling and storing of hazardous liquids.

The Beryllium Corp. of Pennsylvania, Reading, Pa., has opened a sales office at 475 Fifth Ave., New York. Thomas F. Davis formerly chief metallurgist of the Philadelphia works of General Electric Co. will manage the new office.

Lukens Steel Co., Coatesville, Pa., has named W. Harrison Lackey sales representative for the company and its subsidiaries in the York territory. Mr. Lackey joined the company in 1936 and recently has been doing sales and engineering work.

Sterling Alloys, Inc., Woburn, Mass, has appointed H. V. Bordeaux as engineering service representative for California. His headquarters are at 649 S. Olive St., Los Angeles. The company also has opened an office at 4 West 7th St., Cincinnati with A. F. Tenney and C. E. Smith in charge.

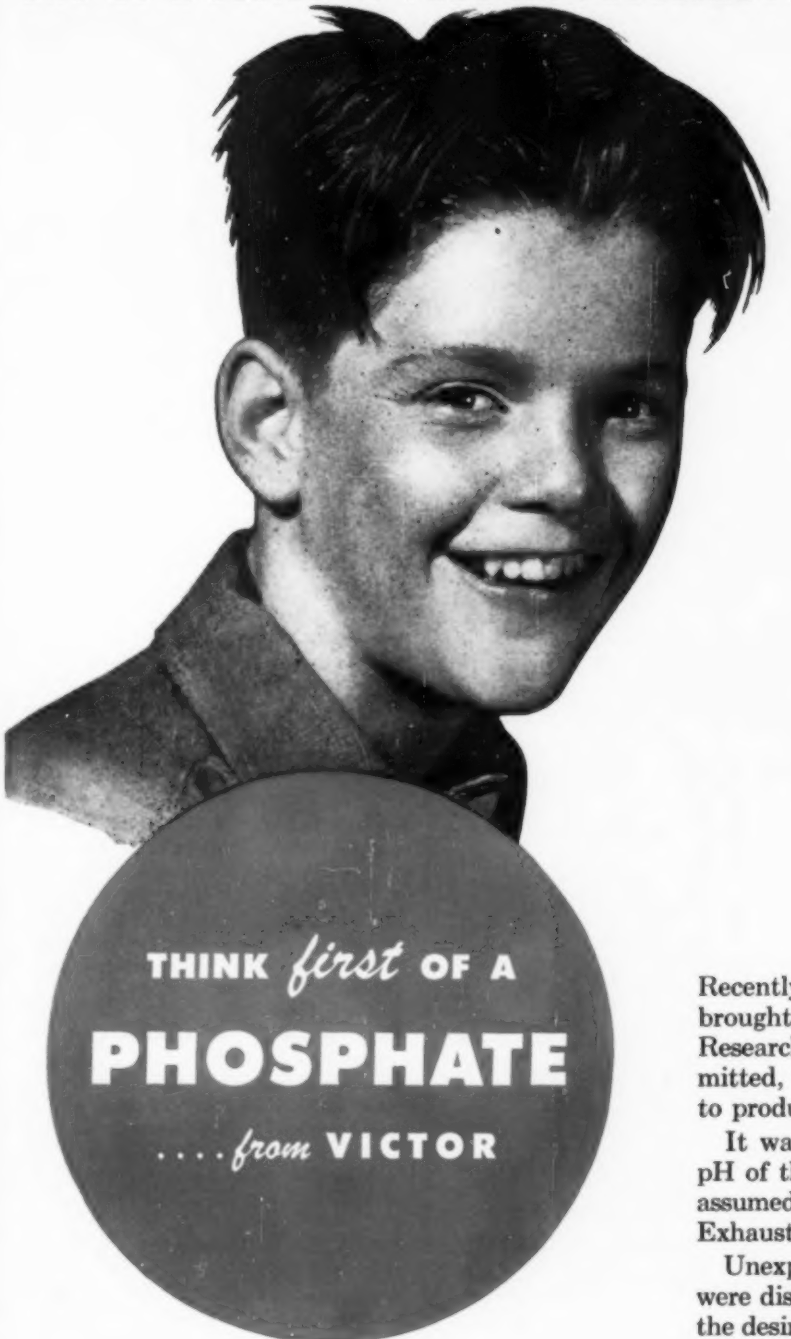
Hercules Powder Co., Wilmington, Del., has selected Andrew VanBeck as assistant director of purchases. Mr. VanBeek had been serving as manager of the Hercules-operated Radford Ordnance Works.

Fisher Governor Co., Marshalltown, Iowa, has given exclusive representation for its products in the Texas Gulf Coast area to Puffer-Sweiven Co., Merchants & Manufacturers Bldg., Houston, Tex.

B. F. Goodrich Chemical Co., Cleveland, has promoted Robert P. Kenney to the position of manager of international sales. Mr. Kenney had been in charge of technical service for the company's foreign business and all lend-lease shipments.

Brooks Rotameter Co., Lansdale, Pa., has been formed by Stephen A. Brooks and seven associates to manufacture rotameter flow rate measuring and controlling instruments. Mr. Brooks is a chemical engineer and for the past six years has served as vice

ONE OF A SERIES OF PRODUCT PROBLEMS . . . *SOLVED WITH A PHOSPHATE*



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SOLVED A COLOR PROBLEM...

Recently, the manufacturer of a food product brought a very interesting problem to the Victor Research Laboratory. According to reports submitted, the product, when added to liquid, failed to produce the exact color desired.

It was suggested that a detailed study of the pH of the mixture be made, the pH having been assumed to be the controlling factor for color. Exhaustive tests disproved this assumption.

Unexpectedly, certain phosphorus compounds were discovered to be quite effective in producing the desired color in the mixture. One in particular was found by a group of competent judges not only to develop the exact color desired, but to produce a more creamy product with better body and improved flavor as well.

Yes, many product problems have been solved by the Victor Research Laboratory by discovering new and unusual applications of phosphorus compounds. For that reason, whenever you are confronted with a product problem it pays to *think first of a phosphate from Victor!* Our laboratory is at your service.

PARTIAL LIST OF VICTOR CHEMICALS

Acids . . . formic, metaphosphoric, oxalic, phosphoric, polyphosphoric.

Formates . . . aluminum, sodium, sodium boro-.

Metaphosphates . . . aluminum, ethyl.

Orthophosphates . . . ammonium, calcium, iron, magnesium, potassium, sodium.

Oxalates . . . calcium, sodium.

Phosphorus (yellow).

Ferrophosphorus

Phosphorus Compounds . . . chlorides, pentoxide.

Pyrophosphates . . . calcium, sodium acid, sodium iron, tetrapotassium, tetrasodium.

Sulphates . . . magnesium, sodium aluminum.

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president in charge of sales and advertising for Fischer & Porter Co. Harry H. Long will be chief fluids engineer in charge of specifications and calibration. Garbutt W. Aiman will be in charge of precision rotameter tube manufacture. Jack Bradley will supervise production and Lou Rosenblum will be in charge of purchases.

Heyden Chemical Corp., New York, has appointed N. P. Malin manager of the Far Eastern sales department. Mr. Malin formerly was export manager for Marshall Dill in San Francisco.

National Starch Products, Inc., New York, recently held a meeting of all the managers of its foreign plants to discuss peacetime manufacture and marketing. Among those present were R. M. L. Francis managing director of National Adhesives Ltd., Slough, England, and Obbe Meijer, managing director of Nationale Zetmeelindustrie, N. V. Veendam, Holland.

Bryant Heater Co., Cleveland, has established an industrial division to develop and distribute gas combustion components for industrial and process equipment. Initial products include a new proportional mixer, high and low pressure injectors, tunnel burners, combustion blowers, and open type burners and cages. Donald A. Campbell is in charge of the new division.

Gotham Instrument Co., New York, has assigned Charles Halpern as regional manager for the West Coast with headquarters in its branch factory in San Francisco. Mr. Halpern was recently released from the Armed Forces. He formerly served the company as assistant sales manager in the eastern territory.

Hercules Powder Co., Wilmington, Del., has announced that Robert L. Skov has been appointed sales manager in the west coast district for the cellulose products department. Mr. Skov formerly was supervisor of western hemisphere exports in Wilmington. His headquarters now will be in San Francisco.

United States Rubber Co., New York, announces that D. W. Walsh has been appointed Pacific Coast sales manager for the tire division and that W. H. Kneass has been appointed Pacific Coast divisional manager. Both men will have their headquarters in Los Angeles.

Ellinwood Industries, Los Angeles, announces the purchase of Parts Mfg. Co. of the same city which operates two automatic electric furnaces and one of the most complete furnace brazing plants on the west coast. The Parts Mfg. division will carry on its present contracts and accept sub-contracting work.

Philadelphia Quartz Co., Philadelphia, has added Dwight L. Turner of Greensboro, N. C., to its sales staff. Mr. Turner, recently released from the Army Air Corps, is assigned to the southern territory.

Koppers Co., Pittsburgh, has appointed Thomas C. Keeling general sales manager for the tar and chemical division. Mr.

Splash Proof Protection

3 OTHER TYPES OF PROTECTION

Form J — General Purpose Application

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Century Explosion Proof Motor

Where There Are Splashing Liquids

Guard Against Production Losses With CENTURY SPLASH PROOF MOTORS

Whether yours as an installation is subjected to splashing liquids — or whether your electric motors must withstand plant washdowns — Century Splash Proof motors will give you protection.

Of course, any falling solids are also kept out of the operating parts of the motor by Century's proven splash proof construction.

Special insulation is available for higher concentrations of acids and alkalies.

Wherever your electric motors must operate in conditions such as these, for safety's sake, specify Century Splash Proof. A Century engineer will be glad to give you complete details about the advantages of Century motors as they apply to your job.

Century C MOTORS

CENTURY ELECTRIC CO.
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Offices and Stock Points in Principal Cities

134

Keeling completed four years as lieutenant colonel in the Army. Before the war he was sales engineer for Niagara Alkali Co. at Buffalo.

The Foxboro Co., Foxboro, Mass., has added Ward S. Yunker to its staff at the home office in the capacity of assistant manager of the fiber industries sales division, specializing in instrument engineering for the pulp and paper industry. The company also has taken on Nels A. Swanson as sales engineer at its branch office in Los Angeles.

Fritzsche Brothers, Inc., New York, announces that Major Charles C. Bryan has returned to its sales division after a lengthy service in the China-India-Burma theater of war.

Pennsylvania Salt Mfg. Co., Philadelphia, has appointed William A. Corwin and Bryce Beard to the sales and service staff of its laundry and dry cleaning division.

Ross-Meehan Foundries, of Chattanooga, Tenn., has added R. King Stone to the organization in the capacity of sales engineer. Mr. King is in charge of the North and South Carolina sales division servicing applications of the company's products.

Conet Products Co., New York, has made T. M. Gibson director of export sales. He had been export manager for J. T. Baker Chemical Co.

National Chemical & Mfg. Co., Brooklyn, N. Y., has named J. M. Spencer field representative in Louisiana, southern Alabama, western Georgia, and southern Mississippi for its Luminall paint division.

B. F. Goodrich Co., Akron, Ohio, has advanced James A. Windram to the position of manager of the St. Louis district of the industrial products division. He succeeds George Livermore who has retired after 30 years spent in the company.

E. I. du Pont de Nemours & Co., Wilmington, has leased a building at Pennsylvania Ave. and Goodale St., Columbus, Ohio, which will be used as a general laboratory for service to the ceramics industry. O. T. Fraser will be in charge of the laboratory.

Enterprise Engine & Foundry Co., San Francisco, has appointed V. F. McIndoe as manager of the firm's combustion equipment division. Mr. McIndoe will have charge of Enterprise combustion equipment and sales in the United States and abroad.

The Cooper Alloy Foundry Co., Newark, N. J., has established a division devoted exclusively to precision casting of small intricate parts.

Strong, Carlisle & Hammond Co., Cleveland has turned over distribution of its products in Texas to Harry E. Clark & Co., Shell Bldg., Houston. The Clark company also plans to open a sales and service branch in Dallas.

ORONITE CHEMICALS THE NAME TO WATCH IN CHEMICALS

MODERN PROTECTIVE COATINGS MUST BE BACKED BY CHEMICAL INTEGRITY

Chemicals which can meet the stiffest tests of modern protective coatings, in all types of applications, are produced by Oronite with the same integrity of manufacture that has characterized all Oronite products.

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CONVENTION PAPER ABSTRACTS

CONTENTS

TEXTILE RESEARCH

TEXTILE fabrics built around the fixed properties of the natural occurring fibers; such as cotton, wool, flax and silk, which were suitable for most prewar uses proved inadequate for military applications during the war. But the war effort did not suffer since new fibers were designed to meet specific needs and the properties of other fibers were modified through chemical finishing treatments to overcome the inadequacies of the available natural occurring fibers. For example: nylon, high-tenacity viscose rayon, Vinyon and Aralac were used in large quantities. The war stimulated such finish developments as shrink resistance processes for wool and water proofing processes for many different fabrics. While the challenging problem to produce a cloth which could be fire, water, mildew and weather resisting was not completely solved, finished fabrics were produced which lasted ten times as long as prewar fabrics.

In the future many new synthetic fibers will be produced, since the chemist can synthesize many new molecules that could not possibly occur naturally. In spite of the assured future of synthetic fibers, cotton and wool will continue to account for the bulk of our fiber requirements. However, these fibers will be subjected to many different chemical processes which will yield a large number of superior modified fabrics.

Milton Harris, Milton Harris Associates, before Southeast Tennessee Section, American Chemical Society, Chattanooga, Sept. 20, 1945.

POSTWAR RECONVERSION CHALLENGES

WE NEED to catch our breath. We need a pause, a change of pace, and fresh briefing on postwar goals. Then to find our places promptly. The immediate tasks of the postwar world are tough and pressing.

Our national plant badly needs repair, replacement and additions. We need to paint, patch, tear down and build back. We must take up again the task of building better living in our cities and on our farms.

We are already at the job of reconversion. The prospect is one of full employment and new products. Expectancy is large as wartime research is focused on peacetime targets.

For the economist as well as the industrialist there is the job of balancing our economy in terms of full production and full purchasing power and a $275 billion national debt. For the statesman there is the assignment to spell out the philosophy and formula whereby private and public enterprise tackle that task.

And finally others will work at regaining lost ground on the educational front; some will read the lessons of selective service physical examinations and push for new gains in national health; many will prepare this nation for effective enjoyment of more leisure time.

For any such assignment there are the raw materials and the manpower—and the space in which to mobilize them. There is an ample reservoir of technology filled to overflowing with wartime research and there is our tested pattern of individual enterprise in production and democracy in government.

But the tests of the immediate tomorrow will not come in areas of resources, sciences, or philosophy but in the everyday experiences of human relationships. We will be working at tough tasks and on occasion, be baffled, doubting, confused and provoked. To weather such periods we will need tolerance, the capacity for adjustment and ordinary good sportsmanship, on a solid foundation of intellectual integrity.

A determining postwar factor will be our course of conduct in collective bargaining, in international relations, in cooperation as between professions, in teamwork as between Congress and the administrative branch, in relations between enterprise and government and especially in attitudes as between a citizen and his government.

J. B. Blandford, Jr., National Housing Agency, commencement address at Stevens Institute of Technology, Hoboken, N. J., October 26, 1945.

STRUCTURE OF COPOLYMERS

BECAUSE of the great variety of structures possible for high polymers, it is difficult to make an appreciable amount of polymer in a strictly chemically pure state. One of the important characteristics of GR-S is its marked heterogeneity, although we do not yet know for sure just what this means in terms of tire performance. Nevertheless, it is felt desirable to learn all that is possible about GR-S in order that we might know more about the factors which determine ultimate performance.

There are three principal types of heterogeneity possible in copolymers of the GR-S type. They are variations in molecular weight or size, variations in molecular shape, and variations in composition. When all three are superimposed, as is actually the case, it is clear that a given

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OF RELIANCE SERIES C MOTORS

1. **Protecting enclosures** keep out dirt, chips, oil, excess moisture.
2. **Steel stators for strength.**
3. **Thirteen-step winding treatment,** for maximum stator protection.
4. **Pressure cast aluminum rotors** provide trouble-free windings.
5. **Heavy shafts,** liberally designed for added strength.
6. **Improved bearing lubrication** affords *real* protection to bearings and windings.
7. **Optional lead outlet arrangement** permits machine mounting with elimination of conduit box.
8. **Flange and face type brackets** offer alternative methods of machine application.

● Reliance Series C Motors are designed and precision built *to make it absolutely impossible to grease them wrong.* On the vast majority of applications, these factory lubricated motors continue to operate *for years* with no additional lubrication whatsoever. In cases where unusual conditions make occasional attention necessary—or if it is your practice to lubricate at regular intervals—undergreasing or overgreasing make no difference. Write for Bulletin C-118 which tells the whole story—and specify Reliance Series C Motors to forget lubrication worries.

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RELIANCE A-C D-C MOTORS

batch of copolymer can scarcely be regarded as a pure chemical substance.

Variability of molecular weight shows up markedly if one follows a polymerization from its start to finish. When GR-S is polymerized, the reaction is usually carried out to about 75 percent conversion, the unreacted materials being recovered and recycled. If one stopped the polymerization earlier or carried it further than 75 percent, the properties of the product would be quite different. Actually it is found that the first polymer formed (say up to 10 percent conversion) is of relatively low molecular weight and would not in itself be a good rubber for tires. The product which forms later has a higher molecular weight so that the final rubber is a mixture possessing average properties which are about right.

Not only does the average molecular weight of a polymer change with conversion, but the shapes of the molecules likewise exhibit variations. Polymer molecules are ordinarily regarded as long chains made up of several hundred to many thousands of links. The variation mentioned above had to do with the lengths of the chains.

The second type of variation involves differences in shape. Instead of all of the molecules being simple chains, many of them have branches which would make them look more like trees than single chains. Moreover, some of the branches might be joined together more than once (by cross-linking) to give rise to a three-dimensional network. If this network is too rigid, it will presumably give rise to a poor rubber as far as processing is concerned. The tendency for GR-S molecules to branch or cross-link increases with increasing conversion of product which is another reason for stopping the polymerization at about 75 percent yield.

The third significant type of variation has to do with composition. GR-S is a copolymer, that is to say, it is made up of two different types of building units. These two types, which are butadiene and styrene, do not possess the same reactivities and hence do not polymerize at the same rate. It so happens that the first polymer to form is relatively richer in butadiene than the reaction mixture; as the reaction proceeds the copolymer molecules contain more and more styrene. This factor is also important when it comes to deciding on the proper conversion, since pushing the reaction too far will give rise to great heterogeneity of composition.

Principal shortcomings of GR-S are due to its marked heterogeneity. However, continued research will disclose methods for controlling these factors and that we can ultimately produce a product with properties better than natural rubber.

Frederick T. Wall, University of Illinois, before Furniture Club of America, Chicago, Oct. 19, 1945.

PHOSPHATES AND PHOSPHORUS

VIRTUALLY a new chemical industry is being built on phosphates. This advance is taking place through the development of the so-called refined phosphorus salts.

Phosphorus played a vital and spectacu-

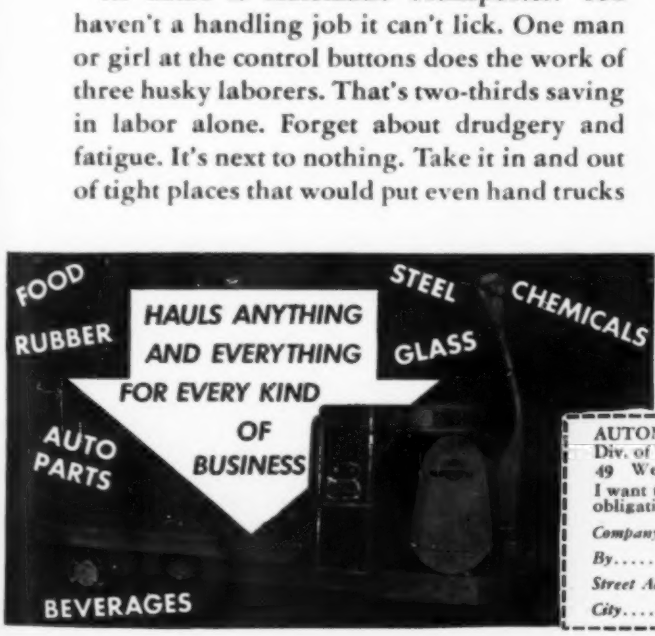
It's Yours to Use *FREE* in Your Own Plant For 3 Days!

to demonstrate it will cut *YOUR* handling costs at least IN HALF

All industry is using this Miracle Electric Truck. In its motor is a Muscle Mike . . . a brawny midget of electric power that moves up to 6000 pounds with amazing "touch-of-your-thumb" ease.

Its name is Automatic Transporter. You haven't a handling job it can't lick. One man or girl at the control buttons does the work of three husky laborers. That's two-thirds saving in labor alone. Forget about drudgery and fatigue. It's next to nothing. Take it in and out of tight places that would put even hand trucks to shame. It comes through for you without a whimper.

But don't take our word for it. Put it to the test . . . put it over the severest hauling hurdles in your own plant. See if it doesn't do for you, the great job it has been doing for industry everywhere. Mail the coupon, and we will arrange delivery. First come, will of course, be first served. There is absolutely no obligation to buy . . . no strings attached whatsoever.



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lar role in winning the war, through its use in smoke screens, fire bombs, spotter shells and the like, but the peacetime services of phosphorus derivatives are even more important.

Although fertilizer, the earliest phosphorus product, continues to represent the largest tonnage, increasing use is being made of phosphates in such varied fields as food manufacture, plastics, textiles, soap-making, and the metal and petroleum industries.

A whole series of new phosphorus compounds is proving of exceptional value in the making of plastics, particularly because of their flame-retarding properties. Textiles also constitute a broad market for phosphates, especially the sodium phosphates. Tetra-sodium pyrophosphate, for example, is used in bleach baths to prevent too drastic action of the bleach.

In food manufacture, phosphoric acid, in conjunction with lime, serves as a clarifying agent in refining raw sugar sirup, by removing protein impurities. In gelatine, phosphoric acid is added as a refining agent, and in jellies it helps control the jelling action. In both jellies and soft drinks, it serves as an acidulant to replace fruit acids such as citric or tartaric acid.

Each adult contains in his system about 1.4 lb. of phosphorus, and therefore requires a continual replenishment of supply, hence the increasing significance in foodstuff preparation of calcium phosphate and sodium acid pyrophosphate, which are used as acid leavening agents. Both release carbon dioxide from baking soda, and the residual salts left after the leavening is completed serve as body nourishment.

The fast-growing packaged cheese industry has been greatly helped by the use of tetra-sodium pyrophosphate and di-sodium phosphate, which keep the cheeses from "oiling off," or giving off their fat in globules of oil on their surfaces. The smooth, creamy consistency of ice cream is assured by the use of di-sodium phosphate to prevent agglomeration of solids.

In fortifying foodstuffs such as flour, ferric phosphate provides a rich source of iron, while tri-calcium phosphate has long been used as an anti-caking agent in salt, sugar and other granular products. Related to the services of phosphates as diet supplements, are their time-honored uses in medicinals and pharmaceuticals, including saline laxatives and dentrifices.

In the metal industries, research has shifted the status of phosphorus from a "nuisance element" to that of an alloying addition of great merit when properly handled. Phosphorus bronzes are widely used in bearings and other friction-resistant surfaces, and in other alloys phosphorus increases corrosion resistance. Phosphoric acid is employed in metal rustproofing treatments, and tri-sodium phosphate and tetra-sodium pyrophosphate are highly effective detergents in metal cleaning.

Phosphorus plays a double role in the manufacture of safety matches, making ignition possible and at the same time affording protection against possible fire. Red phosphorus is a necessary constituent of the striking surface and phosphorus sesquisulphide makes possible low temperature ignition of the match tip, while the stem of the match splint is impregnated with

You can BLOW HOT OR BLOW COLD

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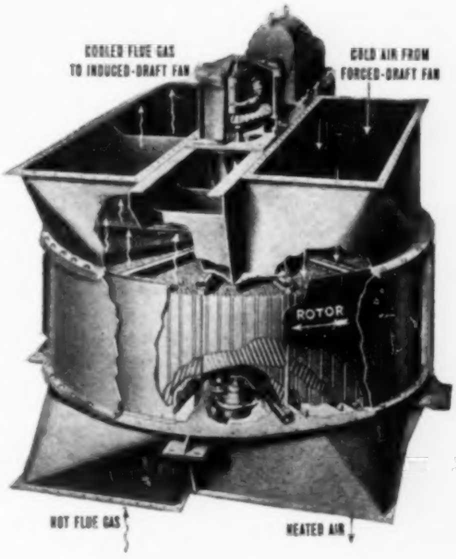

The Ljungstrom Air Preheater is a versatile heat exchange unit. In addition to preheating combustion air to temperatures as high as 1,500 deg. F, it can be applied where cooling is the objective. Cooling involving low-temperature air or gases may be accomplished with units developed by Air Preheater engineers.

Ljungstrom Air Preheaters are already making major contributions to chemical, synthetic rubber, refining, smelting and waste disposal processes.

ENGINEERING SERVICE — The engineering staff of the Air Preheater Corporation is fully prepared to assist you in applying standard or special types of Ljungstrom Preheaters to your individual heat-exchange problem. To get the full benefit of preheat engineering, we suggest that you call in the preheat engineer while plans for remodeling, or new construction, are still in the formative stage.

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mono-ammonium phosphate to make sure it does not continue to glow after its work is done.

Tetra-sodium pyrophosphate also performs an important service in the manufacture of industrial and household soaps, which are of great value in hard-water areas because they contain their own water-softening agent. The same phosphorus derivative is a standard chemical in the petroleum industry, being used to reduce the viscosity of clays and bentonite mixed with water so that the muddy mixture can be handled easily to flush away the rock chips it contains.

Paul Logue, Monsanto Chemical Co., before Alabama Section, American Chemical Society, Birmingham, Ala., Oct. 18, 1945.

PETROLEUM POLICIES

The basic answer to America's future oil needs lies in technology and free enterprise rather than the new high total of more than twenty billion barrels of proven reserves in the ground. Technology is the indispensable finder, developer, and multiplier of our natural resources, and given a fair chance will accomplish even more in the future than it has in the past.

The most essential element of national oil policy is to leave the industry free to develop on a tried and proven basis, and shun the adoption of measures which would attempt to regiment research, destroy the incentives to invention, or prevent the free play of competitive enterprise.

In spite of repeated and widely circulated "scare stories" during the last 25 years predicting an imminent shortage of oil, the American petroleum industry, operating freely and competitively, has never failed to meet the public requirements.

Given a continuation of a legal and economic climate conducive to free competition in discovery, research, development, and distribution, the industry knows a dozen ways in which any possible demand can be met, even though it cannot predict just which of these methods will prove most efficient and economically desirable when the time comes.

The long term trend in U. S. demand, especially for gasoline, is expected to be upward, so that in the period from 1961 to 1965 about three-quarters of a million more barrels of petroleum will be required every day than in 1944, or two million barrels above prewar levels. If production eventually falls behind consumption, the situation can be met either by some method of forcing a balance between domestic demand and supply, such as permitting the price mechanism free play, thereby stimulating production and discouraging consumption, or by importation of enough crude to make up the deficit.

An important policy which will permit the needs of industry and individual consumers to be met at reasonable prices and yet not flood the market or keep prices at a level which would discourage an adequate amount of exploration, wildcatting, and secondary recovery activities for many years to come is essential to the health and vigor of the domestic industry.

Deficiencies could also be met by improving techniques already known for getting petroleum products from natural gas, oil shale, and coal. Coal deposits alone

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AVAILABLE NOW

POLYTHENE'S outstanding chemical inertness makes it the ideal material for many uses—gaskets, tubing, and packaging are three that polythene is admirably suited for. At room temperature, there is no known solvent for this lighter-than-water thermoplastic (specific gravity 0.92).

Add to this the fact that Du Pont polythene, although flexible in thin sections, is relatively rigid in thick sections, and you have another reason for its adaptability to a wide range of uses.

Polythene is tasteless, odorless, and non-toxic. Its water-absorption is less than 0.005%

Polythene can be injection- or compression-molded, extruded or calendered. And now that this versatile plastic is for the first time freed from wartime restrictions, you'll see it aiding industries in a host of applications old and new. For properties chart and complete data on polythene, write E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J.

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... THROUGH CHEMISTRY

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could supply abundant liquid fuel for more than a thousand years, but it is quite possible that even before petroleum deposits are exhausted still other and cheaper sources of power will be developed. Our technologists have not lost their magic touch.

While the practical application of knowledge of atomic power must be preceded by much research and development, and while the economics might never justify the building of new plants to make the raw materials for atomic power, it seems quite possible that the next decade may see commercial applications of power development in large units from raw materials made in our present plants.

The possibility of atomic power certainly cannot be disregarded and constitutes another reason why we should not insist on a sharply limited use of existing resources when the rapid pace of technical development might conceivably make such resources less needed in the future than they are today.

R. E. Wilson, Standard Oil Co. of Indiana, before Special Committee Investigating Petroleum Resources, Washington, Oct. 3, 1945.

OPPORTUNITIES AND OBLIGATIONS

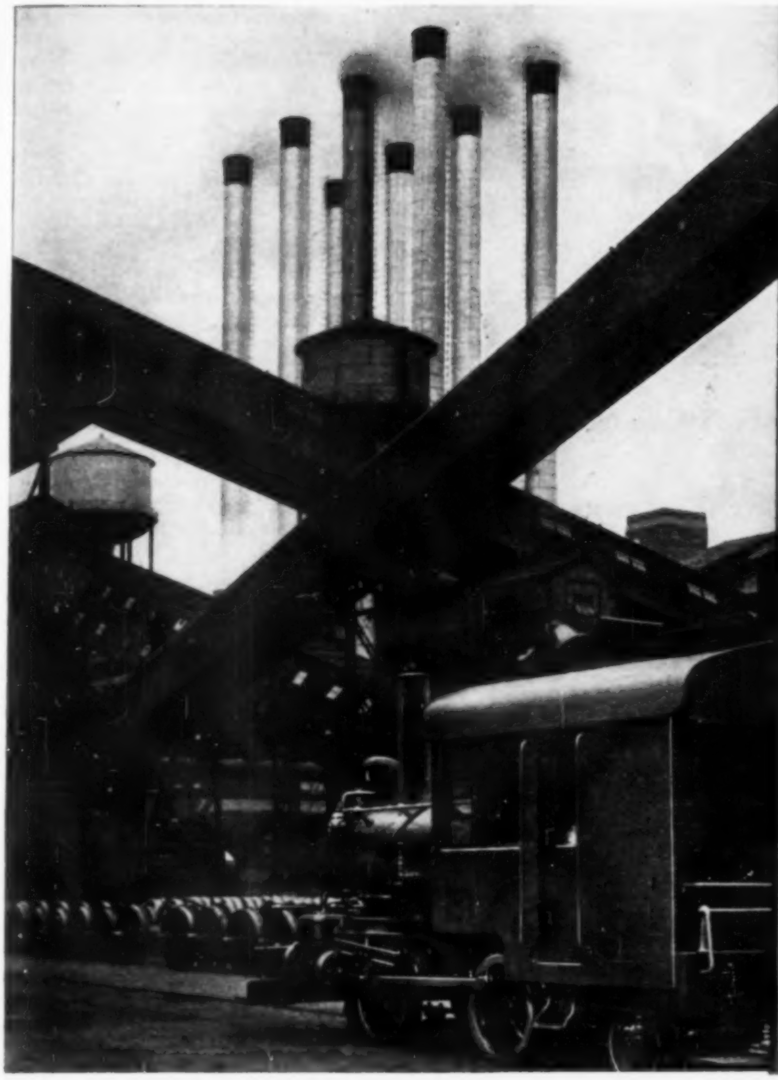
War has interrupted the training and preparation of men for the engineering profession to such an extent that those who are best able to appraise the situation express genuine alarm. This opinion comes from employment authorities in industry, from government analysts of the distribution of professional services, and from the spokesmen of professional organizations.

Before the war, the phrase "age of technology" had come into common usage. The technical developments made during and after World War I, the startling results of scientific discovery and invention in the twenties and thirties, and the miraculous results of new industrial processes combined to create a popular appreciation of the importance of science and technology.

World War II has even more dramatically focused our attention of science and its applications. Those best qualified to speak judge that we made, in the period of the war, scientific, technological, and engineering progress that would not have been achieved in a fifty-year span of normal activity. Such compression of scientific achievement in all fields, from engineering to medicine, both amazed and startled us. Radar, synthetics, streamlined engineering, robots, penicillin, and a host of other technical achievements came with such rapidity we no longer felt surprised when a new "secret weapon" or process was announced.

In education, we expect that students will be conditioned more than ever to receive instruction in the sciences and technology. They will be science-minded and technology-minded. They will expect much from our educational institutions and they have every right to believe that we shall be adequately prepared to give them the knowledge necessary to equip them for living in the modern world.

Our professional obligations are several. First, we must have an ever-alert, well-trained, well-informed teaching staff. Science is changing so rapidly that the effective teacher of a scientific subject can-



Multiply Production by Effective Lubrication

EFFECTIVE lubrication—because it assures efficient, trouble-free operation of machinery—multiplies production figures, subtracts from production costs. Texaco Products and Texaco Specialized Engineering Service will give you effective lubrication because you can count on Texaco for:

1. Lubricants developed for your particular type of equipment and proved in actual service.
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Proved effectiveness in increasing production and lowering costs in many important fields is the reason why Texaco is used by plant operators everywhere. It will pay to find out what Texaco can do for *you.*

Texaco Products and Texaco Specialized Engineering Service are available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write The Texas Company, 135 East 42nd St., New York 17, N. Y.

RECONVERSION RUSTPROOFING

4 Points to Remember

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2. These instructions require that only rustproofing materials meeting Government specifications be used.
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not rest upon the knowledge gained during his period of preparation for teaching. This generalization applies to all teachers, but the demands upon science teachers are imperative. Not only must the science teacher be "up to the minute" in his own knowledge, he must also know the newest and best methods of teaching science to his students.

Beyond the teaching of science subjects is the importance of teaching the scientific attitude. The core of progress in science and invention is the inquiring mind. Science teachers are not only imparters of knowledge; they should also be devoted to stimulating in their students that intellectual curiosity essential to stretching the mind to encompass all achievements possible.

Knowledge of science and appreciation of the scientific attitude are still not enough. The third element in effective science teaching is the scientific method. The hard, cold handling of materials, unlimited by inhibitions of emotional analysis or the frailties of human bias, is the method of the scientist.

If we have an obligation to provide this kind of vital, significant teaching in science, we also have an obligation to help students to learn to use the tools of science effectively. To attempt the teaching of modern science with obsolete equipment and antiquated materials should no longer be permitted.

—David D. Henry, Wayne University, before Gray Iron Founders' Society, Chicago, Oct. 24, 1945.

THE CONSULTANT AS A BUSINESS MAN

Business relations between consultant and client can take many forms. Usually, the client is engaged in manufacturing or intends to manufacture, and has a problem. The consultant is in a position to help answer that problem. The problem must either be worth solving from the standpoint of dollars and cents, or there must be secondary reasons—as nuisance, relation to competition, etc. In the former case, there must be a relationship between cost and value, in the second, cost may be secondary but still within limits.

The relationships between client and consultant can fall into three classes: The short term single trip job—a month to a year; the longer term continuation of the job—one to several years; the continuing relationship—one where the profits are continually shared.

In approaching a connection between a new client and a consultant, it would be well for both to consider carefully these three possibilities and to choose the best one for the benefits of both. The character of the problem, and the certainty of its solution primarily should influence the choice. Other factors should be the character of the client's business and the financial condition of the consultant.

On such problems as analyses, market evaluations, litigations on patents, etc. it makes little difference what the client's business or the condition of the consultant's finances is. These fall into the class of services rendered and paid for. They may or may not lead to other relationships of a more continuing nature. These problems

are to be regarded as opportunities. Through them one meets the members of a client's organization, gets some feeling of the business.

In considering the situation wherein the consultant's relations with the client are of long standing, we must first analyze the characteristics of the consultant, the client's problems, the client, and such things as policy.

Generally speaking, consultants fall into two general classes so far as any one problem is concerned: (1) They are specialists in one or more of the fields of use for many chemicals; (2) they are specialists in the field of manufacture of one or more chemicals. Generally speaking, a client's problems also fall into two classifications: (1) They have to do only with existing manufacturing operations; (2) they have to do with extensions of their present manufacturing operations to make either raw materials or more finished products.

It is not the trick scientific analysis, the good research jobs which you do for other people, nor the good jobs of house-breaking production for somebody else which will make you money. The consultant should analyze both problem and client, and pick those cases where he makes a major contribution to the success of the venture, and then demand and take a continuing share in the profits.

Wm. M. Grosvenor, Jr., before Association of Consulting Chemists & Chemical Engineers, New York, Oct. 23, 1945.

INDUSTRIAL EXPANSION IN CHINA

Tremendous expansion in industrial and engineering chemistry will take place in China. Chemical industries will be established in non-coastal areas and in areas served by new motor highways. Formerly, industry was centered in Shanghai and two or three other large centers.

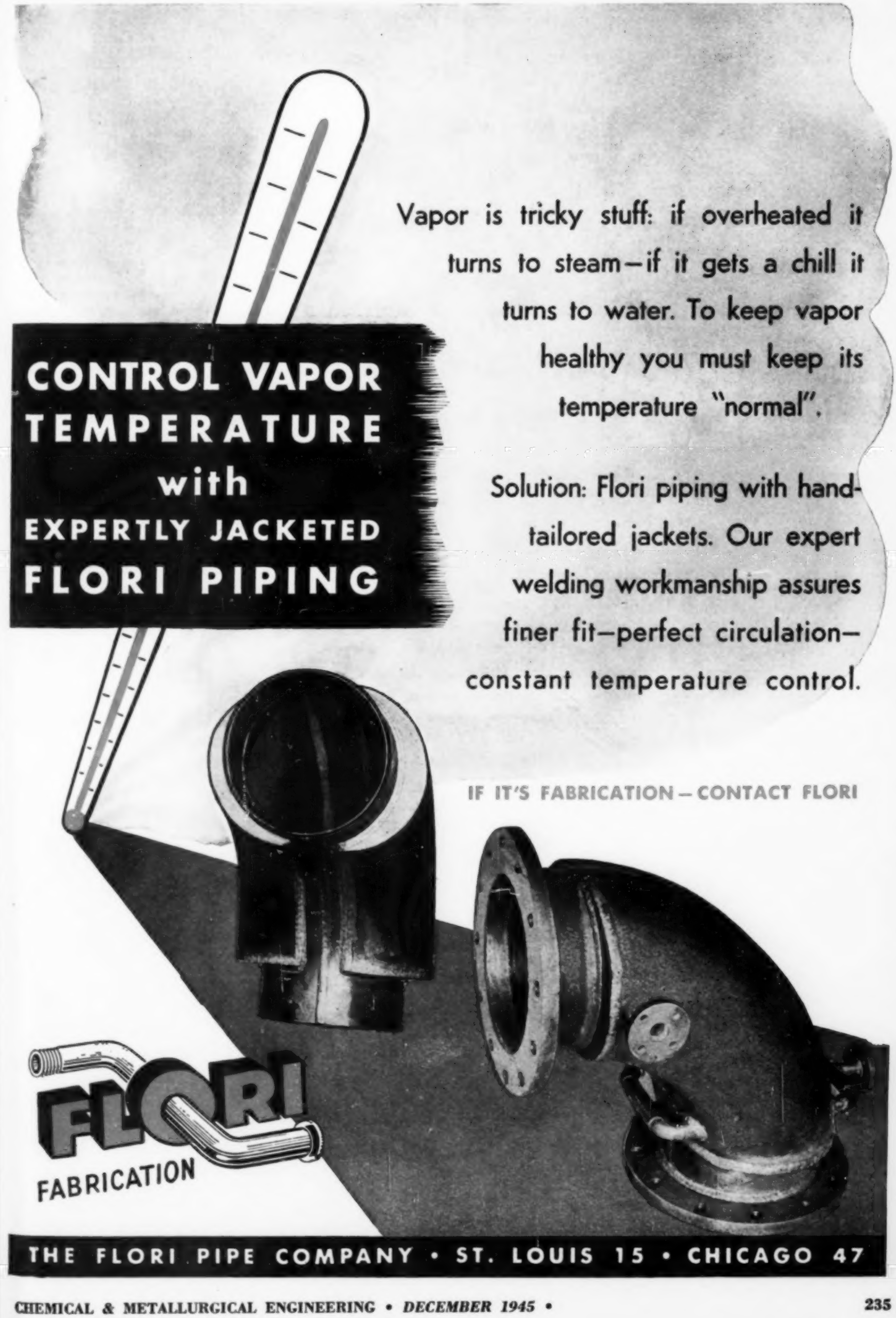
During the war, chemical research in China made notable advances, especially in explosives, pharmaceuticals, liquid fuel, including vegetable gasoline, refractories, and solid fuel. China's most pronounced triumphs in the industrial field, include solvay soda and nitrogen fixation.

China will foster trade relations with western nations on a cooperative basis, but will resist exploitation. Extra-territoriality and the trade advantages enjoyed by other countries in the prewar period will no longer prevail. China will look to the United States for capital and mechanical equipment as well as for technical experts.

China, with its population of 400 million, represents a tremendous potential market. The Japanese recognized this and flooded the country with cheap consumer goods. The United States will probably not be called upon to supply the Far East with knick-knacks and gadgets, but American aid can be used in the larger plans for industrial development.

It is a mistake to think of China as without a chemical industry. Beginnings have already been made, but is is important to realize the need for a much fuller development. World War II, which began for China in 1937, was a stimulus to industrial growth.

The government has realized the lack of a substantial industrial fabric in the



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national economy, and is drawing up extensive industrial plans under the National Resources Commission. Organization of industry will be speeded by the assistance of a large number of chemical engineers and technicians trained in the United States and England during the war years. Substantial chemical research has been under way in China for about fifteen years. Research centers have been functioning in eight or ten of the leading universities.

A new type of cooperation is needed in the Orient. One of the most far-sighted acts of the United States government was that which returned to China several decades ago large amounts of an old war indemnity. This, as an investment, not only paid returns in good will, but it paved the way for cooperative industrial developments which neither China nor America have had reason to regret.

William H. Adolph, Cornell University, before New York Section, American Chemical Society, New York, Oct. 5, 1945.

THE ATOM BOMB AND GERMAN SCIENCE

The Germans were working on atomic power, and with good results. They knew of uranium fission and how to get it. In fact they knew practically as much about it as we did, but were far from putting their knowledge into effect because of the incapacitation of their industrial plants.

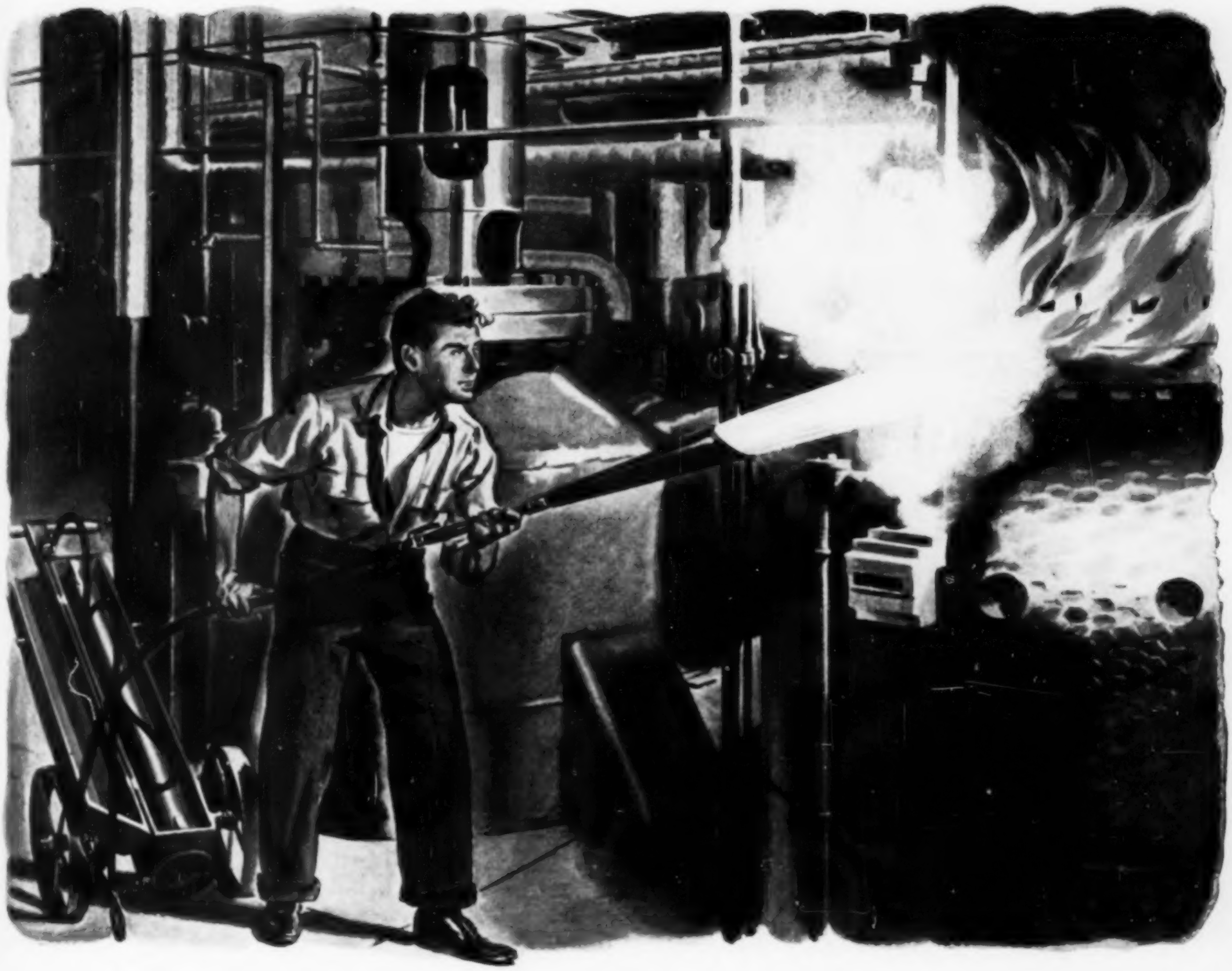
At the present time, no other nation in the world could have built an Oak Ridge, Tenn., the "atom city" of 80,000 created to produce this new weapon. No other country was close to harnessing atomic power at the time our forces dropped atomic bombs on Japan, but other nations can and will discover its secrets in the near future. Ten years from now a lot of countries will have worked out the secrets in their own scientific laboratories and will have the means for putting them into effective use. Widespread knowledge of atomic power uses and other powerful weapons already produced and in the course of development will make military manpower a much less potent factor in war.

Right now the United States has the greatest concentration of scientific brainpower in the world—a force of able American scientists abetted by many learned nuclear physicists who came to this country as refugees. Certainly, we have the greatest engineering and industrial capacity in the world. But what we have done can and will be done by others in time.

It is a fact that, with a few notable exceptions, the Germans really did a much less thorough job than we have done in the United States. In only one or two specialized fields, such as aerodynamics and jet propulsion, did their research effort approach ours. The many scientists questioned were almost uniformly glad to tell everything they knew and the majority were bitter over the manner in which the Nazis had treated German science.

On the other hand, Nazi industry and engineering had done a good job of producing war machines. In spite of this, the German army was pitifully under-mechanized to fight against the highly superior mechanization launched by the Allies.

Germany had no worthwhile secret



weapons almost ready for combat use. We found some of the top German scientists almost childish in their inability to be practical. One professor, selected by Goering to organize all German science, had spent much time on development of a bomb that descended in large spirals so that, as he put it, "people wouldn't know where it was going to strike." The childish part of this was that the Germans didn't know where it was going to strike, either, and they seemed to fail to realize that it is almost impossible for persons on the ground to judge the striking point of a bomb, whether it spirals down or comes down almost straight.

—A. A. Bates, Westinghouse Electric Corp., before Hungry Club, Pittsburgh, October 1945.

CHROMIUM PLATING DEVELOPMENTS

While the electroplating of such metals as nickel, copper, and cadmium was very drastically curtailed during the war, chromium was sufficiently plentiful to permit extensive use of heavy electrodeposits of this metal on materials vital to the war effort. This was indeed most fortunate. Through the use of hard or heavy chromium plating, it was possible to salvage or to extend the life of countless tools, dies, gages, and an infinite variety of machine parts.

Perhaps of equal or greater importance was the use of porous chromium electrodeposits on internal combustion engine cylinders and piston rings. By means of this process, the performance of many thousands of diesel engine cylinders was greatly improved and extended. In addition, many thousands of worn cylinders, particularly of the airplane engine type, were reconditioned by porous chromium plating and returned to service.

Preparation of base metal for satisfactory plating may be roughly divided into two parts. First, it is necessary to secure the required finish or surface profile; and second, the necessary degree of cleanliness must be provided to insure proper bonding of the electrodeposit to the base metal. There are two methods of obtaining very desirable base metal surface finishes for plating which have been fairly recently perfected.

After preliminary finishing by conventional methods, most steels, including ordinary carbon steel, may be readily electropolished to the reguired degree of smoothness and any cold worked "skin" is effectively removed. This procedure has the additional advantages that it polishes recesses otherwise inaccessible and it develops very desirable radii on all edges or corners of work treated. Used prior to chromium plating, care should be taken to prevent "drag-over" of the polishing electrolyte to the chromium plating bath.

Another method of obtaining a very suitable surface finish for chromium plating is known as liquid honing or Vapor Blasting. In this process the metal surface is blasted with an aqueous suspension of abrasive material known as Novaculite. The abrasive particle size is generally very small and may be as fine as 2,000 mesh or about 5 microns mean diameter. Although there must necessarily be some cold work-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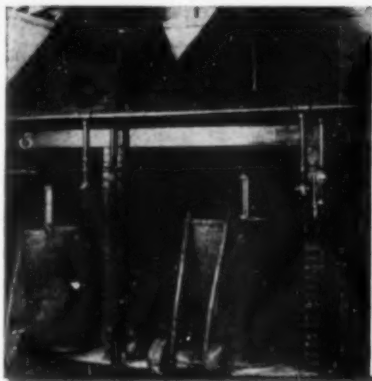
ing and peening of metal surfaces, these effects are minimized when very fine grit sizes are used. As with electropolishing, this process has the advantage of reaching into very small recesses and it also effectively de-butts sharp edges or corners. It can be used to advantage where, due to part geometry, electropolishing entails too great danger of contamination of the plating bath by drag-over. Cast iron parts which cannot be successfully electropolished may be vapor blasted to obtain a desirable surface finish for deposition of heavy chromium deposits. These newly perfected methods of preparing ferrous base metal surfaces are of considerable assistance in obtaining a more reliable bond of the chromium deposit with base metal and in reducing the frequency of such defects as pits, bare spots, and nodular growths.

Ordinary electrodeposited chromium would at first appear to be an excellent material for surfacing the cylinder bores of internal combustion engines. The metal has good resistance to corrosion caused by sulphur and many of its compounds and such corrosion is considered by many authorities to be an important factor accelerating cylinder wear. Chromium is also well known for its low coefficient of friction and its great hardness which are desirable properties in a bearing material. However, ordinary hard or dense chromium in cylinder bores has yielded rather disappointing results because quite frequently scoring or scuffing of the cylinder walls occurs. One of the principal reasons for this trouble is the fact that dense, bright chromium will not wet with or retain a sufficient amount of lubricating oil to prevent metal to metal contact of the sliding surfaces under the conditions prevailing in engine cylinder bores.

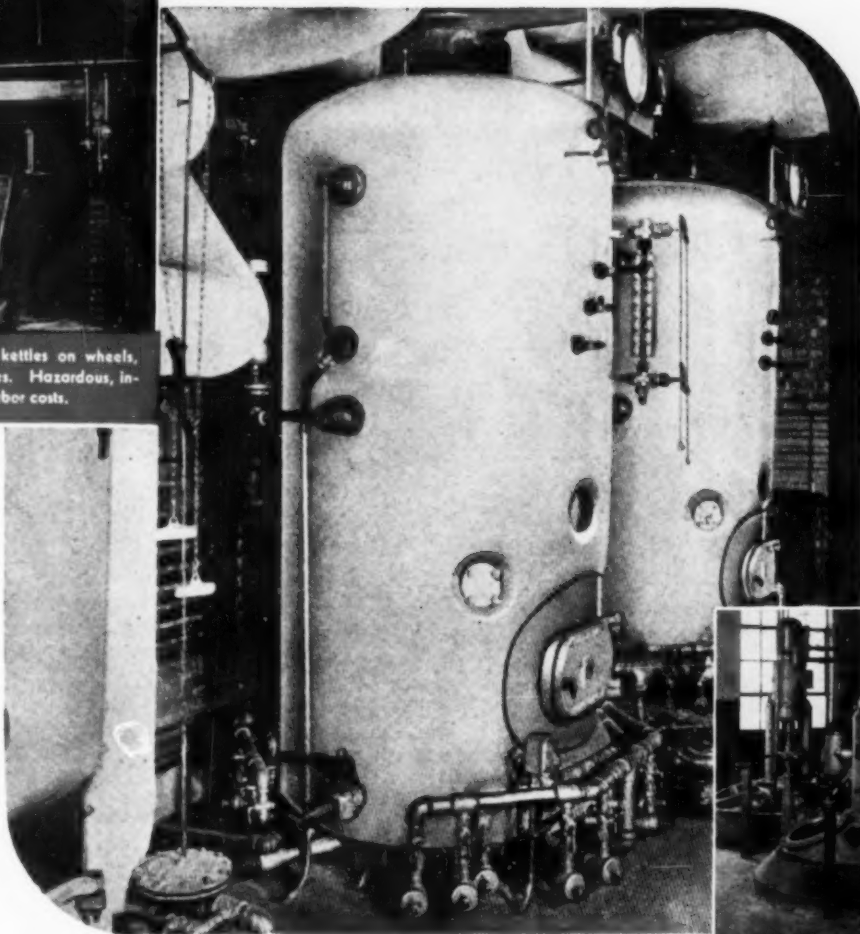
In order for chromium electrodeposits to retain lubricating films under such extraordinary conditions the metal must be provided with almost microscopic oil reservoirs. In the Van der Horst process, chromium is first deposited under very closely controlled conditions of bath composition, temperature and current density. This is followed by anodic treatment which preferentially dissolves chromium in such a manner as to develop recesses in the deposit in the form of small pockets in one variety of porosity, and in the form of a network of grooves or channels in another variety.

Base metal surface profile is of paramount importance in heavy chromium plating and in porous chromium plating the surface finish should measure not more than 10 micro-inches and preferably less. The main surface of a cylinder bore is generally brought to the required degree of smoothness by honing. Following this, all corners and edges that are contiguous with the bearing surfaces are wheel polished and smooth radii obtained in order to prevent the formation of rough or treed chromium in these areas.

It will be readily appreciated that very close dimensions must be maintained in engine cylinders and, therefore, the plate thickness must be as uniform as possible. A variation in rate of deposition of as little as 5 percent may often be more than can be tolerated by dimensional specifications. Because of the negative throwing power of chromium plating baths, it is necessary that



Old-time heavy varnish kettles on wheels, over gas, oil or coke fires. Hazardous, inefficient, high labor costs.



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the anode surface be as symmetrical with the cathode surface as possible and uniform anode-cathode gap distance be maintained. Anode design for precision chromium plating of inside cylindrical surfaces is a complex problem. From the standpoint of maintaining the proper concentration of trivalent chromium in the plating bath, the anode surface should be as large as possible.

Following anodic treatment or porosity etching, engine cylinder bores are invariably polished or honed so as to clean up minor dimensional irregularities and to develop highly finished plateau or bearing surfaces. Honing or polishing debris is effectively removed from the porous surfaces by means of steam gun cleaning.

J. C. Poor, Van der Horst Corp. of America, before Cleveland Section, The Electrochemical Society, Cleveland, Sept. 22, 1945.

PORCELAIN ENAMELS

Porcelain enamel is a highly corrosion-resistant inorganic substance. Generally, it has been used commercially not so much because of this property but for the reason that it is colorful, durable, easily cleaned and economical to apply. Thus it has found its largest usage as a finish for such items as stoves, refrigerators, washing machines, cooking ware, and the like. Its possibilities as a functional finish strictly for high corrosion resistance have only recently been fully recognized and exploited.

Porcelain enamel is a completely inorganic substance which by composition is a glass that can be bonded by a fusion process to a metal base—usually iron. To manufacture porcelain enamel, refractory substances, such as feldspar and powdered quartz, are intimately mixed with fluxes, such as cryolite, borax and fluorspar and oxidizing agents such as saltpeter. The mixture subsequently is brought to quiet fusion in an open hearth type fuel fired furnace. The molten glass is discharged from the smelter into water. This sudden cooling causes the molten glass to break into millions of friable particles, granular in form, known as "frit."

To prepare frit for application to the metal, it is first ground in pebble mills with water and clay to a fine suspension of the glass particles in the water. The special clays used in the process act as floating and suspending agents. The milled enamel which has a consistency about like thick cream may be applied to the metal base either by dipping or spraying. After this, the water is evaporated by inserting the ware in a hot air dryer. The article with its bisque coating is placed into a muffle type fuel fired or electric furnace and brought to a temperature of approximately 1,550 deg. F. Under these conditions, the glass particles remelt forming a homogeneous layer of glass which bonds to the metal. Subsequent coatings are applied in similar manner, each layer fused and bonded to the layer of glass underneath.

Enamels are formulated to yield properties suitable to the use for which the enameled article is designed. Uniform specifications can not be applied to all enamels for all purposes. Enamels can be made highly resistant to all organic and

inorganic acids (except hydrofluoric) and to normal alkaline solutions. Porcelain enamels are not resistant to highly concentrated caustic solutions at boiling temperatures since these solutions are excellent solvents for silicates. All enamels are not made acid resistant because, in general, these types of enamels are more difficult to apply which means relatively higher costs in the process. Acid resistance does not always guarantee that the enamel will be suited to the conditions of service. For example, weather and water resisting enamels may be also acid resisting, but all acid resisting enamels are not weather and water resistant.

During the war, many new types of corrosion resistant ceramic coatings or porcelain enamels were developed for ferrous metals. It was found that many articles formerly manufactured from heat resistant and corrosion resistant metal alloys could be manufactured at lower costs from available low carbon enameling stock and mild steel and coated with one or two applications of special enamels. Frequently these enameled items were found to be better than the original made from metal alloys.

New types of enamels were produced and used in the manufacture of hot water storage tanks for government and private housing. Enamels completely resistant to the solvent action of hot water to pressure had not been discovered prior to the war. Such enamels are now available and undoubtedly will be used in the postwar period. Other examples of application of enamels for corrosion resistance are "glass lined" chemical equipment, "glass lined" pipe used successfully to resist hydrogen sulphide corrosion in the natural gas fields of Texas.

Porcelain enamel has often been criticized as being unsatisfactory for corrosion resistance because porcelain enamel is subject to damage by impact. It must be remembered that enamel is a glass and if treated as such in handling will remain most durable. When enameled articles are handled properly to prevent mechanical damage, long life and excellent protection of the metal surface will result.

Another criticism of porcelain enamel has been that corrosion often occurs in localized spots. The manufacturer who produces the enameled item often does not fully realize the requirements of a coating material specifically for corrosion resistance. Likewise the producer of the items is often at fault in not making known the full specifications or requirements of their proposed usage. When the requirements are fully understood, it is usually possible to produce a completely satisfactory enamel coating. The average manufacturer of enameled articles has thought of porcelain enamels in terms of its beauty and average mild corrosion problems and does not realize that for chemical and complete weathering resistance the surface of the metal must be completely covered. Hence, articles are sometimes enameled and put into service with minute spots of the surface not covered. Enamel does not offer any electrolytic resistance to corrosion as do most types of metallic coatings and corrosion will occur rapidly in such unprotected areas. However, when the sur-

face of the metal base is completely covered by the proper type of enamel the surface will withstand indefinitely such tests as salt spray, acid solution (except hydrofluoric) and weathering.

G. H. McIntyre, Ferro Enamel Corp., before Cleveland Section, The Electrochemical Society, Cleveland, Sept. 22, 1945.

NOTES ON PACIFIC NORTHWEST CHEMICAL INDUSTRIES

We know with certainty what has happened to West Coast industries during the war, but we do not know what is ahead —whether contraction, expansion, or status quo—for the West Coast industrial structure which war has made so big and so important. It is necessary to remember that the controlling basic factors of markets, raw materials and technology still apply. No legerdemain can negate the principle that no product can be sold profitably and competitively unless it is of better quality, lower priced and more adequately marketed than its competitor.

The Pacific Northwest industrial structure has materially changed since the war, although some of the changes had commenced before Pearl Harbor. In chemical production, several new plants have become established to add to the already important ones operated by Hooker and others in the Puget Sound and Lower Columbia river areas. Three calcium carbide plants were operated. One in Portland, is owned and operated by the Pacific Carbide and Alloys Co., a subsidiary of the Stewart Oxygen Company of San Francisco. The Electrochemical Company operates another furnace in Portland. In Tacoma, Pacific Carbide and Alloys operated still a third plant for the Government. This plant is now closed. Incidentally, it employed self-baking electrodes of the Soderberg type. The future of the carbide industry in the Northwest is all ahead of it.

The Pennsylvania Salt Co. at Tacoma and Portland operated large and modern plants for the production of chlorates and related chemicals. The aggressiveness of this company together with its definite consciousness of research, presents a very hopeful picture of expansion and diversification. The same observation applies, of course, to the Hooker plant and management in Tacoma.

In the field of carbon, the Portland Gas and Coke Co. has continued its well-balanced program in the production of oil carbons and derivatives. It is a bright spot in a important and critical field. In Seattle, the Seattle Gas and Coke Co. continues to be very active. The one coke plant in the region is at present closed, but it probably will be reopened in the not too distant future. It was established by the Wilkeson Co. in Tacoma, using Curran-Knowles low-temperature coke ovens. The washed and blended coals of certain high quality coal mines of Puget Sound, together with a "sweetening" of petroleum coke, produced a highly satisfactory grade of carbon for the domestic, commercial, and metallurgical markets. The difficulties which closed the plant were not technological and the obstacles ahead are by no means insuperable.

Other chemicals have come into produc-

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The much greater than usual resistance of C 531 to attack by hydrochloric acid is due to the formation of a self-repairing insoluble antimony film, combined with the inherent resistance of a high nickel-chromium alloy containing copper and molybdenum.

Further details will be gladly furnished upon request.

COOPER 531

Chemical Composition

CR—10-14
Ni—27-30
Mo—3-4
Cu—3-4
C max.—.10
Si—.5-.8
Mn—.5-.8
Sb—.4-.6

Mechanical Properties

TS—50-70,000 PSI
YP—40-45,000 PSI
E12"—15-30%
BHN—125-140

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tion in Northwest plants of Stauffer, General Chemical and others. Aluminum chloride, aluminum sulphate, and various insecticides are included among new products. A new plant was established in Idaho by Simplot for the production of superphosphates. Glucose is being manufactured in Wenatchee, Wash. by the Northwest Chemurgic Corp. to use potato and wheat starch. Naturally, all have heard of the huge "mystery" plant at Hanford. As an innovation in the United States, attention should be called to the new electro glass furnace recently placed in operation at Northwestern Glass Co. in Seattle by its designer and protagonist, Ungve Cornelius.

In the field of plastics, the growing importance of synthetic resins and coatings has brought new names and new managements to the region. The Laucks Co. —a pioneer in the Pacific Northwest—is now a part of the Monsanto empire, and this change is believed by some to be a precursor of expanding activities on the coast by Monsanto, such as the production of formaldehyde. The Reichhold Chemicals Corp. is to build a plant in Seattle for the production of phenol, urea, and resorcinol-based adhesives and alkyd resins for coatings. The Casein Co. of America is to build a formaldehyde plant at Springfield, Ore. The DuPonts are actively examining possible locations for a rayon plant. Of related, even though independent importance, of course, is the production of ethyl alcohol in the Pacific Northwest.

Our current discussions and preliminary negotiations with industrial interests show that our belief in the drawing power of the hydroelectric resources of the region is well founded. Additional zinc production is not altogether in the distant future. Electrolytic iron, lithium, more calcium carbide, rayon, abrasives, phosphorus, and several other major industrial materials are "on the books" at the time for active discussion.

The really critically missing basic material is carbon, and on this there must be and will be a campaign of development, both as to raw material sources and as to treatment.

Ivan Bloch, Bonneville Power Administration, before American Institute of Chemical Engineers, Northern California Chapter, San Francisco, Sept. 20, 1945.

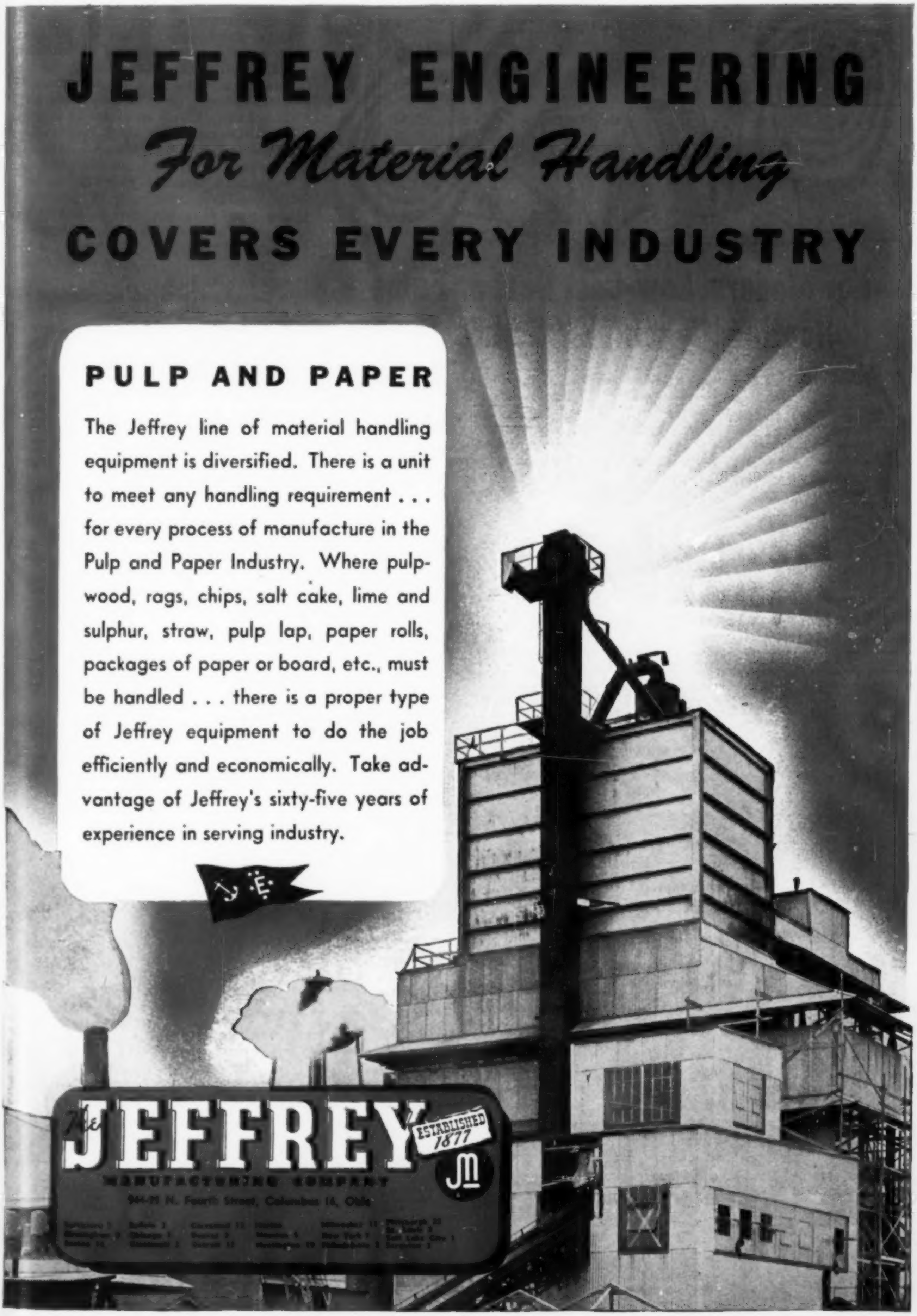
NICKEL RIBBON AND FOIL 0.1 MICRON THICK

As a part of the development of an alternating current bolometer, a method for the production of very thin nickel ribbons and nickel foil has been developed.

Using copper foil about 0.002 in. thick as a base, nickel was deposited by the ordinary electroplating method. The copper foil cathode was supported by folding it flat around a copper plate. This allowed deposition of nickel on only one face of the copper foil.

A double edged shearing punch was used to cut the copper foil, nickel plated on one side only, into ribbons 0.038 cm. by about 5 cm. One of these ribbons was then soldered to a platinum wire frame.

When the ribbon was fixed to the platinum frame, the copper was dissolved



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electrochemically. The frame with the nickel plated copper ribbon was immersed in a concentrated solution of potassium cyanide. The copper dissolves, going into solution as a complex copper cynamide, while hydrogen gas is evolved at the platinum frame. This is an advantage over the Wollaston method in which gas is evolved at the surface of the ribbon.

When the ribbons are very thin, removal of the frame and nickel ribbons from the cyanide solution must be carried out slowly and with great care to prevent the breaking of the ribbons by the surface tension of the liquid. The frame and ribbons were washed in distilled water and then in acetone.

Using a similar technique, nickel foil was prepared in sheets about 5 cm. by 5 cm. From the measured area and the weight of the foil, the thickness was determined. When the thickness is plotted against the plating time (at the constant plating current density corresponding to 0.100 amp.) used to produce the foils, a linear relationship is obtained.

In addition to this method, ribbons of known width and length were prepared and the resistances determined. Using the bulk resistivity of nickel, the thicknesses of the ribbons were calculated. The two methods are in good agreement.

Ribbon filaments have been prepared which are as thin as 0.1 micron. These filaments appear to possess the properties of bulk nickel. The method is not restricted to nickel, bismuth ribbons having been prepared by the same procedure.

F. G. Brockman, North American Philips Co., before Optical Society of America, New York, Oct. 18, 1945.

INCREASED ACIDITY OF VARNISH FILMS ON AGING

A METHOD has been developed for titrating the acids in drying-oil and oleoresinous varnish films. The method is similar to ordinary acid number titrations, except that it is run on a semimicro scale and the indicator used is Victoria Blue B. The titrations are more time-consuming than ordinary acid number titrations, since the films do not dissolve completely and the rate of neutralization is determined by diffusion processes. However, very good reproducibility is obtained and duplicate titrations check within ± 0.1 acid number unit.

Using this newly developed titration technique, several linseed oil varnish films together with linseed and tung oil films were studied for acidity development over a period of one month. It was found that all these films developed a very high acidity. Those vehicles which practice has shown to possess superior resistance to alkali were the vehicles which developed acidity most slowly. Accordingly, a series of experiments was carried out in which the alkali resistance as well as the acid number development was studied. It was found that the alkali resistance of the vehicles studied could be correlated with the acidity of the films, disregarding the age of the films.

Phenolic resin varnish developed acidity more slowly than the other varnishes, indicating that this resin possessed antioxidant

properties. The acidity development of the varnish films can be repressed by using traces of elementary sulphur as an antioxidant; such treated films showed the expected improvement in alkali resistance.

The very large increase in acidity occurs only when panels are air dried and not when they are baked, substantiating prior contentions that the chemical changes in baking and air-drying are different.

Methanol extractions remove approximately 50 percent of the total acids of the film, indicating that the acidity probably develops by oxidative scission of the fatty acid chains, leaving on an average one carboxyl group attached to the gel network, and the other attached to a short fragment.

V. J. Frilette, Ridbo Laboratories, at the Meeting-in-Print, American Chemical Society, September 1945.

PETROLEUM AS A CHEMICAL INDUSTRY

Petroleum refining is becoming more and more a chemical industry. Its tendency is toward the development of specific chemical processes that yield products which have precise characteristics. Physical separations by fractional distillation and crystallization are giving way to processes which produce individual compounds, such as isopentane, isooctane, triptane, isobutylene, butadiene, isoprene, acetylene, toluene, cumene, and styrene. Chemical compounds such as phenols, cresols, aldehydes, ketones, organic acids, resins, plastics, explosives, synthetic rubber, and many other derivatives are being produced from petroleum.

The industries based on the newer chemistry, involving aliphatic hydrocarbons as base materials, have infinitely greater possibilities than the industries based on coal tar chemistry, even though it is estimated that coal tar has served a source of about 500,000 derivatives. Coal tar hydrocarbons are mainly aromatic in character which limits the number of derivatives which can be produced from them. In comparison, natural gas and petroleum are veritable treasure troves of paraffin, olefin, acetylene, cycloparaffin, cyclo-olefin, and aromatic hydrocarbons that open vast vistas in chemical research which have been only faintly explored. In view of the great number of hydrocarbons available as starting materials, it is not unlikely that over a million new organic compounds will be produced from petroleum and natural gas. The larger number of aliphatic hydrocarbons potentially available compared to the aromatic hydrocarbons in coal tar is due to the number of isomeric modifications in the paraffin, olefin, and acetylene groups. In the paraffin series there are over four thousand isomers having fifteen carbon atoms in the molecules, and when the carbon atom content is 30, over four billion hydrocarbons are possible. In the mono-olefin series, because of the additional factor of different locations of the double bond, the fifteen carbon atoms group comprises thirty-six thousand isomeric forms, and the twenty carbons atom group, over four million. When these are considered as starting materials for new compounds, it is difficult to over-estimate

the potentialities, and the field which opens up is a challenge to the organic chemist.

Petroleum is now known to consist mainly of varying proportions of three main hydrocarbon classes; paraffins, cycloparaffins, and aromatics; olefinic and cycloolefinic hydrocarbons are absent at least in the low-boiling fractions. The gases and the lighter fractions recovered as low-boiling liquids in primary petroleum distillation are essentially paraffinic in character. As the boiling points of the distillates increase cycloparaffins and aromatic hydrocarbons appear, and recent work has shown that the hydrocarbons in the heavier portions comprising the lubricating oils and residual fuel oils and asphalts are polynuclear in character. The proportions of n- and isoparaffins, clycloparaffins, and aromatics in gasoline from different crudes vary widely. In one gasoline exhibiting high knocking tendencies the ratio of n-paraffins to isoparaffins, cycloparaffins, and aromatics is high, and as knocking decreases the proportions of isoparaffins, aromatics and cycloparaffins increase. The extent of this variation is indicated by the fact that some gasolines derived from petroleum have octane ratings as low as 20, while others may have ratings as high as 75.

In seven representative naphthas, fifty-two individual hydrocarbons have been isolated. They include six normal paraffins, nineteen isoparaffins, sixteen cycloparaffins, and eleven aromatic hydrocarbons.

Petroleum, although mainly composed of hydrocarbons, contains sulphur, nitrogen, and oxygen compounds. Free sulphur, as well as hydrogen sulphide and mercaptans, dissolve in some oils, and the two compounds are also constituents of some natural gas. The amounts of sulphur present in crude petroleum vary from 0.1 to over 5 percent, being greatest in oils of a naphthenic or asphaltic character. The majority of the sulphur compounds in petroleum are heterocyclic, some of which are thiophanes. Some straight run distillates and a large proportion of cracked products contain mercaptans many of which are undesirable on account of their offensive odor. These mercaptans are used as odorants for heating gases and as sources of chemical derivatives.

The nitrogen compounds present in petroleum are heterocyclic and of the general character of alkylated quinolines and isoquinolines. Relatively large amounts of these compounds are found in Californian and Russian oils, the total nitrogen content being sometimes as high as 2 percent. When nitrogen-containing oils are cracked, ammonia and amino compounds are produced. A new chemical industry based on nitrogen compounds derivable from petroleum is still open for research and is but one big target for tomorrow.

The oxygen-containing constituents of petroleum are usually referred to under the generic term of naphthenic acids, although they include some aliphatic acids and phenols, particularly cresols and xylenols. Cracking of petroleum increases the phenol yields. These compounds are recoverable by the use of alkalis and acidi-

fying. The phenols are used for the production of resins, plastics, insecticides, and for creosoting wood. The manufacture of naphthenic acid soaps and metal naphthenates for use as paint dryers forms the basis of an extensive industry.

There is a definite trend in petroleum refining in the direction of special products having high market value. These products include not only hydrocarbons synthesized from the original petroleum fractions, but derivatives produced by the use of specific reagents. Many synthetics and derivatives are now on the market in commercial quantities. One company is now producing over 100 products, including 24 alcohols, 4 ketones, 23 esters, 13 amines, and 35 other compounds. The products derivable from petroleum sources are many and various, and include high antiknock hydrocarbons for aviation fuels, rubber bases, solvents, insecticides, fungicides, disinfectants, resins, flotation agents, fertilizers, detergents, cosmetics, perfumes, refrigerants, combustion accelerators, and anesthetics. There is every reason to believe that the development of special products from petroleum will be enormously enhanced in the postwar era.

Gustav Egloff, Universal Oil Products Co., before Cleveland Section, American Chemical Society, Cleveland, Oct. 17, 1945.

THE FUTURE OF PHARMACEUTICAL CHEMISTRY IN THE SOUTH

SYNTHESIS of new and better prophylatic and curative drugs, which is one of the most effective means of combating disease, has been accelerated by recent research. The rapid advancement in pharmaceutical research must not be allowed to diminish in our postwar era. Better techniques for discovering new drugs, more information on the mechanisms of drug action, and a great deal of fundamental knowledge of the biochemistry of life and disease are needed.

Pharmaceutical research chemists have been moderately successful in synthesizing drugs for the treatment of disease and the alleviation of pain. But the problems are not being attacked hard enough. Society has not yet seen fit to devote its resources to the problems of health to a degree commensurate with the advantages to be gained. It is easier to obtain appropriations for a monument than for research. The former glorifies the memory of the dead, but the latter promotes the welfare of the living. The answer to many health problems can be found if enough time and manpower are devoted to them.

The South is peculiarly suited for research of drugs because its abundance of rare and unusual plant life makes suitable an intensive research for new pharmacologically active principals of natural origin.

Funds both public, private, and industrial should be supplied in larger quantities and earmarked for research. This will lead to the development of the necessary fundamental knowledge and with it a higher standard of living and it will also greatly assist in the training of the young scientists of the future.

G. Bryant Bachman, Purdue University, before Southeast Tennessee Section, American Chemical Society, Chattanooga, Sept. 20, 1945.

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The characteristics and properties of this chlorinated hydrocarbon indicate a wide spread utility in many different applications. Trichlorcumene (Isopropyl Trichlorbenzene), a mixture of isomers, is a colorless liquid with a mild aromatic odor. Of particular interest are its extremely low solubility in water, its high degree of resistance to oxidation and hydrolysis, and its unusual dielectric properties. Miscible with most common organic solvents. F. R. -30° to -45°C. B. R. 245° to 265°C. Trichlorcumene is suggested for use as hydraulic fluid, transformer, and dielectric fluids, anti-freeze additive for hydraulic, dielectric and heat transfer fluids, solvent for fats, oils, waxes, coal tar dyes, asphalts; solvent, diluent, and plasticizer for protective coating and insulating compositions; ingredient of insecticidal compositions, paint and varnish removers, paints, solvents and plastics. Write for technical data sheet No. 347 describing more completely its physical properties.

PRODUCT *Formula; Molecular Wt.*	**DESCRIPTION** (Sp. Gr. 15.5°/15.5°C)	**SUGGESTED USES**	**AVAILABILITY**
Chlorpropane Liquid 170 $C_3H_{1.5}Cl_6$(aver.); 268	Clear, colorless liquid. Sp. Gr. 1.725±.025 B.R. 195° to 260°C. Insoluble in water, soluble in alcohol, ether and most chlorinated solvents. Resistant to oleum, mixed acids, fuming nitric acid, and hydrogen fluoride.	Plasticizer, solvent, paint softener, insecticide, rubber and plastic modifier.	Pilot plant quantities.
Chlorinated Paraffins CP-20	Amber colored, viscous liquid, 42% chlorine.	Ingredients of compositions for flame, water and mildew proofing textiles. Ingredient of fireproof paints and other compositions. Plasticizers for various resins and polymers.	55-gal. drums containing 525 lbs.
CP-70	Amber colored resin, 70% chlorine. Powdered.		Fibre drums containing 150 lbs.
Chlorpropane Wax 130 $C_3H_{0.15}Cl_{7.85}$(aver.); 311	Tough, white crystalline wax. M.R. 110° to 155°C. B.R. 210° to 270°C. Insoluble in water, soluble in alcohol, ether and most chlorinated solvents. Resistant to oleum, mixed acids, fuming nitric acid, and hydrogen fluoride.	Plasticizer, dielectric wax, ingredient of pyrotechnic compositions, chemically resistant lubricant.	Pilot plant quantities.
Hexachlorbutadiene $CCl_2{=}CCl{\cdot}CCl{=}CCl_2$; 260.7	Clear, colorless liquid. Sp. Gr. 1.675±.025 B.R. 210° to 220°C.	Solvent for natural rubber, synthetic rubber and other polymeric substances, high boiling non-flammable solvent, non-flammable heat transfer liquid, transformer fluid and hydraulic fluid.	Pilot plant quantities.
Isopropyl Chloride $CH_3CHClCH_3$; 78.5	Clear, colorless liquid. Sp. Gr. 0.867±.003 B.R. 5° incl. 35.4°C.	Manufacture of rubber chemicals and other synthetic chemicals; as a solvent. Intermediate for insecticides and antiseptics.	5-gal. cans containing 35 lbs. 55-gal. drums containing 375 lbs.
Lauryl Chloride, Tech. $C_{12.6}H_{26.2}Cl$(aver.); 213.2	White to amber colored oily liquid. A mixture of n-alkyl chlorides, typical chlorine content is 16%. Insoluble in water, soluble in most organic solvents.	Intermediate in production of various esters, mercaptans and sulfides. Manufacture of detergents.	55-gal. drums containing 375 lbs.
Lauryl Pyridinium Chloride, Tech. $C_5H_5N(C_{12.6}H_{26.2})$ Cl; 291.9	Yellow-gray semisolid, soluble in water.	Cationic detergent in rayon industry. Manufacture of bactericidal and germicidal solutions.	Barrels containing 100 and 375 lbs.

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FOREIGN LITERATURE ABSTRACTS

CARBON ACTIVITIES

CARBON is activated by means of zinc chloride which dissolves impurities contaminating the carbon particles and increases their active surface. This active surface is also increased by rearrangement of the carbon atoms. Carbon with a high capillary activity is prepared by impregnating cellulose for several hours with a solution of zinc chloride of such concentration that the cellulose does not swell. The excess solution is removed by filtration. Carbonization is then carried out at reduced pressure while the temperature is raised slowly to 400–500 deg. during a 12-hr. period. After the carbonization tube is cooled the vacuum pump is stopped and the product introduced into water acidified with hydrochloric acid and filtered. The paste thus obtained is pulverized for 15-30 min. between two plates of ground glass, washed in a flask and filtered. The carbon powder left on the filter is mixed with a solution of saturated zinc chloride, filtered and activated again under reduced pressure and at 410-450 deg. for 2-3 hr. After activation the product is introduced into water acidified with hydrochloric acid, boiled and filtered. It is boiled again for 5–10 min. with a solution of hydrochloric acid (1–2 cc. of concentrated acid in 100 cc. of water), filtered and washed several times with boiling water. After two to three such washings the product is washed with boiling water until the chlorine ion disappears in the filtrate. The moist carbon thus obtained is pulverized between glass plates and dried in the air on another glass plate. Final drying is carried out under reduced pressure in a thermostat at a temperature of 200 deg. for half an hour.

Digest from "Contribution to the Study of Carbon Activated by Zinc Chloride" by Kandilarow, *Kolloid-Beihefte* **48**, 1-32, 1943. (Published in Germany.)

BERYLLIUM

BERYLLIUM has attained such prominence in such a short time because of its unusual properties. Its modulus of elasticity is next to that of tungsten and iridium. Its resistance to torsion in a copper-beryllium alloy containing only 2 percent beryllium is so great that no deformation has been detected after two billion revolutions. It also has extraordinary compressibility, thermal, electrical and other properties. It dissolves in aluminum and magnesium in all proportions giving these metals entirely new and advantageous properties. The future of the aircraft industry depends on beryllium since it will permit safe increase in speed. One of its important uses is in beryllium-copper alloys for making non-sparking tools. Many beryllium-containing minerals have already been located in districts of Colombia. Although beryl is the only one being used industrially at the time, others such as helvite, gadolinite, hambergite, danalite and beryllium tungstate could be used industrially too. Since beryl is a semi-gem it is too expensive as a raw material upon which to build an industry. Gardner suggests beneficiation of scattered beryllium compounds by washing them out with water or looking for these compounds in shale, schists, graphite deposits, clay, sands, bituminous coals and oil wells. Since beryllium compounds are among the best catalysts known they are frequently found in association with other minerals. Colombia is particularly promising as a source of beryllium compounds since it has vast amounts of pegmatite veins, rich oil-bearing regions, numerous carbon and graphite deposits, shales, schists, lignites, titaniferous ores, silicates, clays, and other raw materials.

Digest from "Beryllium, its Sources and Uses" by Daniel Gardner, *Revista Colombiana de Quimica*, **1**, No. 1, 16-21, 1944-1945. (Published in Colombia.)

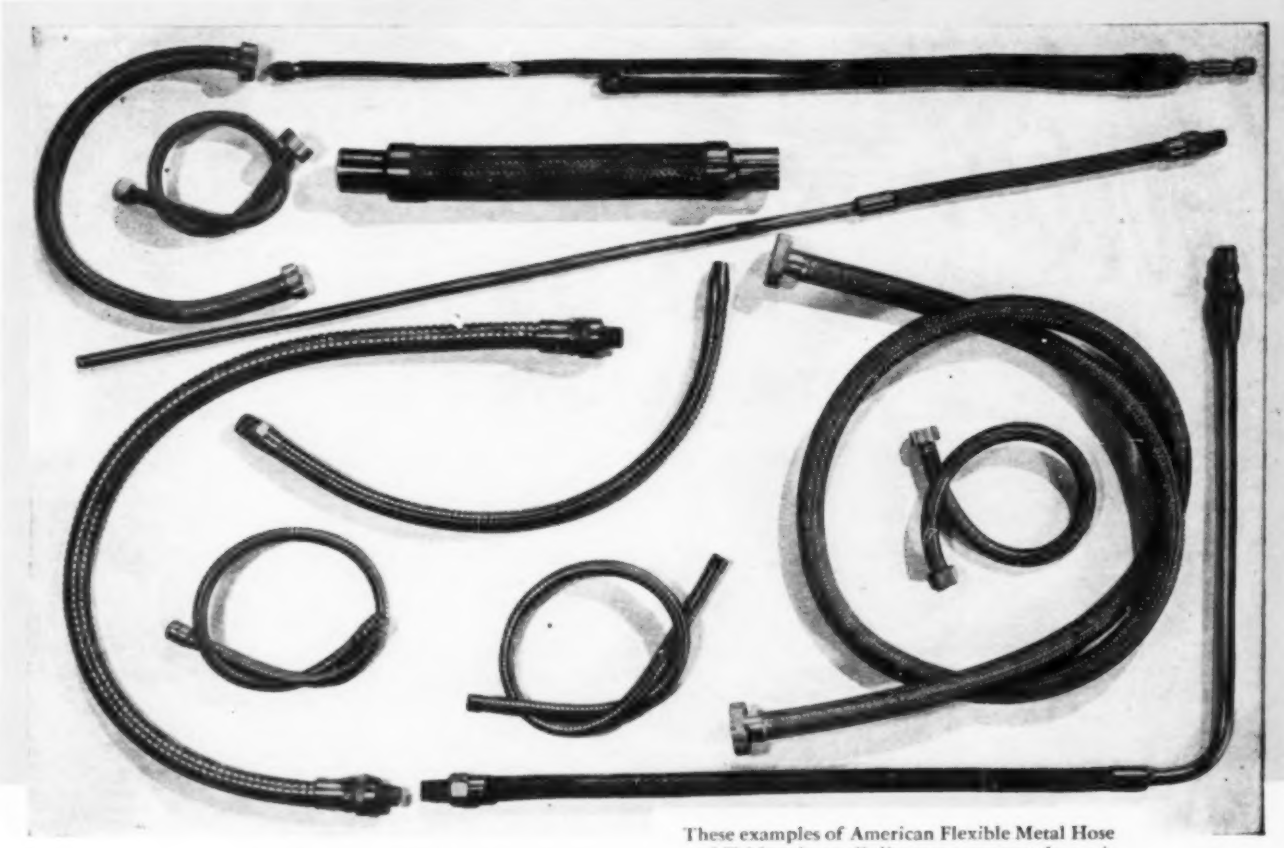
LAMINATED PLASTICS

EMPLOYMENT of laminated plastics is increasing daily and will obviously continue to grow in the postwar period. Although a series of such plastics has already been established in industry, there is room for a great deal of progress. A study was made of pressed bakelized woods and similar materials combined with cellulose or fabrics. Particular attention was paid to the optimum quantity of resin to be added as well as the most suitable pressure, temperature and time. Optimum pressure for impregnation was found to be 200 atm. Below this pressure impregnation is unsufficient and the plastic shows fragility, porosity, etc. Above this pressure there is no improvement in the properties of the product but an enormous increase in the cost. The best quantity of resin is 7–8 percent for pressed wood, 25-30 percent for cellulose strips, 30–40 percent for fabrics. Expansion increases with decrease in the proportion of resin. The materials assume a stable form after staying in the kiln for 8 hr.

Digest from "Technology of Laminated Plastics" by K. Grosmann, *Plastiques*, **2**, 57, 1944. (Published in France.)

CALCIUM IN PORTLAND CEMENTS

PRESENCE of tricalcium silicate in portland cements leads to formation of a large quantity of lime during hydration. This basic compound has a tendency to combine chemically with compounds of an acid nature, thereby depriving the granules of cement of the protection given them by the colloidal calcium hydroxide formed by hydration, depending on the nature of the salt formed. The sensitivity to acids characteristic of portland cement is demonstrated in subterranean and underwater structures and in all cases where formation of $CaCO_3$ interferes with the above-mentioned colloidal type of protection. On the contrary, when substances which have a good proportion of active silica are added, silicic acid can react with the lime liberated in hydration, yielding compounds which have a protecting action due to their colloidal character. Slags from high-temperature furnaces, trass, etc. are ground together with portland cement yielding cements of lower



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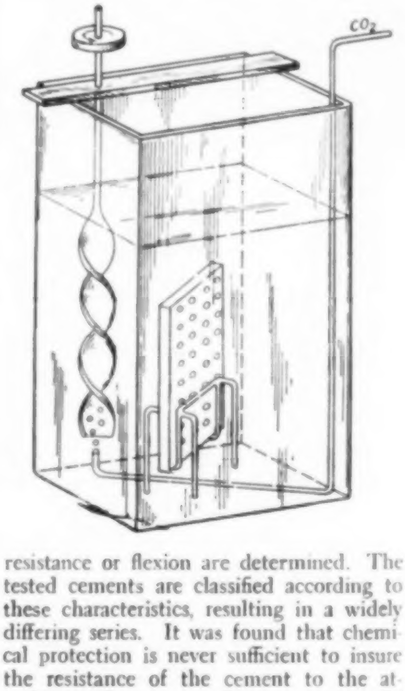
sensitivity to acids than portland cement alone. The differentiation between protecting action of a physical-colloidal or chemical nature is shown by using different test pieces of ordinary German manufacture, either mixed with materials which contain active silica or alone. The test pieces used were extremely porous and were subjected to the action of pure water saturated with carbon dioxide in an apparatus such as that shown in the attached illustration. The container has a capacity of 40 liters. The water is replaced as soon as its lime content exceeds 0.2 g. per l. The diagonal position of the test piece is observed and the piece so arranged that most of its surface is exposed to the attacking substance. The test pieces are in the form of 1:5.5 mortars made with ordinary, inert sand. The possibility of secondary reactions through products which could be formed by corrosion of the vessel is eliminated by using glass. The test pieces were removed at time intervals of from 3 to 210 days, and the losses in weight, variations in volume, lime content of the water, degree of corrosion of the test pieces and variations in

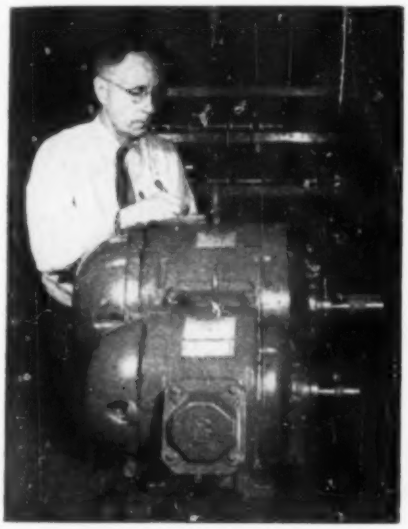


resistance or flexion are determined. The tested cements are classified according to these characteristics, resulting in a widely differing series. It was found that chemical protection is never sufficient to insure the resistance of the cement to the attacking substance, carbonic water. Of course there is a type of chemical protection in which the age of the concrete plays an important role, since the protecting reaction which develops slowly increases the stability of the latter. In all cases in which the concrete is resistant to the attacking waters, the resistance must be attributed to the decrease in porosity by colloidal swelling of a physical type which adds its action to the insufficient protection of the physical type. According to this, the siliceous materials added to the cement should be judged more by their capacity for colloidal swelling by hydration than their equal reactivity with the $Ca(OH)_2$ liberated in the hydration of the cement.

Digest from "Contribution to the Study of the Solution of the Lime of Portland Cements and Mixed Cements with a Portland Base" by R. Zollinger, *Zement* 32, 17-18, 1943. (Published in Germany.)

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor



Each of these motors delivers 10 hp. at the same speed. Reason for increased power in smaller motor is the use of Silicone insulation which withstands higher operating temperatures

INTRODUCTION AND REVIEW

The Technology of Plastics and Resins. *By J. Philip Mason and Joseph F. Manning. Published by D. Van Nostrand Co., New York. 493 pages. Price $6.50.*

Reviewed by W. P. Moeller

In this latest book on the plastic field, the authors have covered the various plastics and allied compounds, as well as giving a condensed resume on the fabrication methods presently used in the field.

Particular emphasis is placed on the chemistry of the long chain molecules with the processing, compounding and application given in a number of the plastic types. It is unfortunate that the authors were working under wartime conditions and, therefore, could not illustrate many of their points by actual wartime applications which often could graphically illustrate the utility of many of the materials which they discuss.

The reviewer believes that the authors' aims, as outlined in the preface, have been achieved, that is "to develop a book suitable for students who have had introductory courses in general chemistry and organic chemistry, and which would serve as an adequate introduction to both the chemistry and practical utilization of plastics and resins. The material should be of interest to men in industry who wish to refresh their knowledge of the fundamentals underlying plastic development and technique."

TIME SAVER

The Chemical Constituents of Petroleum. *By A. N. Sachanen. Published by Reinhold Publishing Corp., New York. 451 pages. Price $8.50.*

Reviewed by John R. Callaham

Progress follows close behind our knowledge of the exact nature of things, for exact data can become a priceless instrument in the hands of the scientist, and the engineer has no tool more valuable than a good reference manual. This is especially true in such fields as the petroleum refining industry where the raw material is an exceedingly complex mixture of organic chemicals. Our present refining technology, undoubtedly one of the most advanced in the entire category of the chemical process industries, has been built around the known facts of the chemical composition of this mixture and the physical data on each of the constituents.

Thus any reference book, like the present volume by Sachanen, which compiles and coordinates a narrow stratum of useful data from the vast and rapidly growing literature, soon becomes of tremendous value as a time-saver to researchers and engineers in the field. Naturally, a good part of the book is devoted to details of physical and chemical methods of determining hydrocarbons in distillates. Two chapters discuss the hydrocarbons found in straight-run and in synthetic distillates. Others deal with petroleum waxes, oxygen compounds, sulphur and nitrogen compounds, resins and asphaltic products. The concluding chapter classifies crude oils according to a new system based on chemical composition. Each chapter contains a bibliography of selected references.

WELL TIMED

Introduction to Magnesium and Its Alloys. *By John Alico. Published by Ziff-Davis Publishing Co., New York. 183 pages. Price $5.*

Reviewed by E. C. Fetter

It is always a happy circumstance when one is justified in applying the word "timely" to a new book. Many authors have turned out praiseworthy work, but they don't often drop it in our laps at the very moment we were awakening to the need for it.

However, Mr. Alico does have that good fortune. Up to now the story of magnesium had been told only in scattered bits and pieces. It remained for Mr. Alico to gather up the fragments and consolidate the ground covered to date by the magnesium industry and magnesium technology. And what luck that this survey of available information should be ready for us just as we emerge from the war period, a period which saw magnesium burst into the limelight, and a period which left large numbers of us uncomfortably aware that "this magnesium stuff must be pretty good and we ought to find out what it's all about."

Mr. Alico tells us what it's all about. He doesn't try to cram in every last scrap of data, but anyone considering applications for magnesium will find the book a good jumping off point.

Just for the record, the topics found in the chapter headings are as follows: History, production, metallurgy, casting, forging, rolling, forming, extruding, heat treatment, surface treatment, machining, joining, and product design. In each case an interpretation of the literature is given in general terms and is coupled with a well chosen bibliography for more detailed investigation.

INDISPENSABLE

Chemistry of Coal Utilization. *Edited by H. H. Lowry. Published by John Wiley & Sons, New York. 1,868 pages. Price $20.*

Reviewed by George Riethof

Dr. Lowry and his 35 collaborators have handled skillfully the enormous task in compiling, in these two volumes, a comprehensive review of the subject. The chapters are well written and many of them give a critical review, while other chapters are, more or less, compilations of references. This may be due in part to the necessity of treating a broad subject in limited space. A good half of the work deals with the physics of coal utilization. For the benefit of the chemist, several chapters, e.g., the petrography of coal, could have been written in a more fundamental manner. The chemistry of coal utilization is practically limitless, and the work contains such chapters as the methanol synthesis from producer gas. The reviewer feels that a chapter on the carbides should find a place in this work, especially a review about calcium carbide and uses of acetylene. The plan of the

RECENT BOOKS RECEIVED

American Chemical Industry—Vol. II. (The World War I Period: 1912–1922.) By W. Haynes. Van Nostrand. $8.

Electronics Dictionary. By N. Cooke & J. Markus. McGraw-Hill. $5.

Handbook of Nonferrous Metallurgy. 2nd ed. (Recovery of the Metals.) By D. M. Liddell. McGraw-Hill. $7.

An Outline of Organic Nitrogen Compounds. 4th ed. By E. F. Degering. Purdue University, Lafayette, Ind. $7.50.

Polarographic and Spectrographic Analysis of High Purity Zinc and Zinc Alloys for Die Casting. H. M. Stationery Office, 429 Oxford St., London, W.1. 5s 4d. postpaid.

committee to publish supplements to the work, rather than new editions, is to be commended. For these supplements it might be suggested that author names not be given in the text, but only in the references, as in a review, which has to mention so many authors the readability of the text is sometimes impaired. The illustrations in the book are mostly excellent, some photographs, e.g. in chapter 39, would reveal more, if they could have been accompanied by a flowsheet or could have been overprinted by a legend. On the whole this book will prove indispensable to anybody whose work is connected with the chemistry of coal. The price is so reasonable that the work can be included in a personal library, and this is the place where a book is of the greatest value.

SPECIFICATIONS LISTED

National Directory of Commodity Specifications. *By the staff of National Bureau of Standards. Miscellaneous Publication M-178, available from Superintendent of Documents, Government Printing Office, Washington 25, D. C. 1,311 pages. Price $4.*

This directory facilitates identification of all commercial, government, and trade association specifications for many commodities which the bureau staff has been able to identify. In its 1,311 pages the directory lists by name, by designating number, and sponsoring organization, every such standard specification or method of test whether of technical, science, or industrial significance. This provides an important guide for those engaged in technical research, market research, or purchasing for any division of process industry.

BIOGRAPHY

Willis Rodney Whitney—Pioneer of Industrial Research. *By John T. Broderick. Published by Fort Orange Press, Albany. 324 pages. Price $3.*

Reviewed by Chaplin Tyler

As Karl Compton says in his foreward to this book—"Few scientists have so impressed their ideals upon their contemporaries as has Willis R. Whitney. He has largely set the pattern and philosophy of the modern industrial research laboratories, one of the unique achievements of this century."

Unlike some biographies of industrial leaders, this one is refreshingly free of any commercial public-relations tinge. It is a plain, informal sketch, as modest as the subject himself. And for *Chem. & Met.* readers it contains a wealth of meaty observations on scientific research. A few typical Whitney observations:

". . . Research is quite as likely to lead to the unexpected as to the expected. Often while we are trying to corral something of which we have a fairly clear mental picture we find something else of more consequence, and the unexpected thus becomes the important discovery or invention, to the discomforture of the prophets, whose clients naturally put their money on the expected."

Of complacency, Whitney says:

"The love of money is said to be the root of all evil. But there's a more noxious

root. It's man's complacency or natural fixity, his tendency to rest upon his oars, to be content with what he thinks he knows. Such progress as we are warranted in boasting of . . . has been made at a snail's pace. That's because complacency or mental fixity is so common, because pioneers are so rare and pioneering is fraught with hazards for any one with a flair for it."

Speaking of budgets for engineering and advertising, the General Electric vice president and one-time research head remarked:

"Rice (Whitney's chief in the early days at Schenectady) used to enjoy working himself up to a ruddy glow of indignation over the relative costs of engineering and advertising. He would say 'Of course one should pay more to produce a useful product that to tell folks about it, but we don't.' He knew that the public did not simply buy things; things had to be completely sold and good engineering had to keep them sold. Therefore, I imagine our research budgets grew large because those of advertising were so much larger."

GAS ANNUAL

AMERICAN GAS ASSOCIATION PROCEEDINGS 1944. *Published by the American Gas Association, 420 Lexington Ave., New York. 500 pages. Price $3 to members; $7 to nonmembers.*

THIS is the usual printing of all of the technical material presented before the association and its technical section during the calendar year 1944. It is a must for technical libraries which cover fuels.

COOPERATIVE PROJECT

COLLECTED PAPERS ON METALLURGICAL ANALYSIS BY THE SPECTROGRAPH. *Edited by D. M. Smith. Published by British Non-Ferrous Metals Research Association, Euston St., London, N. W. 1. 162 pages. Price 21s.*

Reviewed by Edwin K. Jaycox

THIS book is a selected collection of 13 papers based on the reports of various panels of the British Non-Ferrous Metal Research Association, Sub-Committee on Metallurgical Applications of the Spectograph. It is a cooperative project as evidenced by the fact that six papers are by members of the association's staff; three from member companies; one from a government department; and three from panels of the BNFMRA.

The book is not intended to be a comprehensive treatise on the spectrochemical analysis of metals and alloys but many of the papers treat in detail various aspects of the techniques involved and practical suggestions are made that will be helpful and of interest to those engaged in the spectographic analysis of non-ferrous metals.

The photographic process and plate calibration are dealt with in the first two papers. The first of these is an excellent discussion of the factors entering into the processing of photographic plates. It is one of the best papers that has appeared on this subject from the viewpoint of the spectrographer. The second paper discusses a method of plate calibration based upon the use of a manganese triplet, the relative intensities of which are known

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Lapp *Process Equipment*

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from spectroscopic theory. The basic principles employed are the same as those of Dicke who has used the iron and copper spectra for plate calibrating.

The other papers deal with the detailed quantitative spectrochemical analysis of aluminum, zinc, lead and copper base alloys, and of platinum. The preparation of electrodes, sampling, the making of standards, the exitation technique and apparatus, the microphotometry, the photographic aspects and the choice of spectrum lines are thoroughly discussed. Most of the elements usually sought in these alloys are adequately covered.

Because the book is a collection of papers, it is difficult to criticize each paper individually without becoming repetitious. On the whole, the papers are well written, and each in its own right is deserving of a place in the literature. For the most part, the papers are written from the point of view of the fabrication of alloys, where melts, or facilities for remelting alloys are available from which electrodes can be cast, and where the past history of the sample is known and is comparable with that of the standards employed. They are not in all cases adaptable for the consumer who has no control over the past history or form in which samples are submitted for analysis.

Spark excitation is employed in most of the procedures described. It is of interest to note that the British use uncontrolled spark units of relatively low voltage 10-15 kv.) and low power (0.25-0.50 kva.). This is in contrast to the high voltage 10-50 kv.) and high power (1.0-15.0 kva.) controlled (Fuesner type) excitation units generally employed in this country, yet the British report precisions comparable to those obtained by workers here.

The book is recommended reading for all those engaged in the practice of spectrochemical analysis.

IMITATION vs. GENUINE

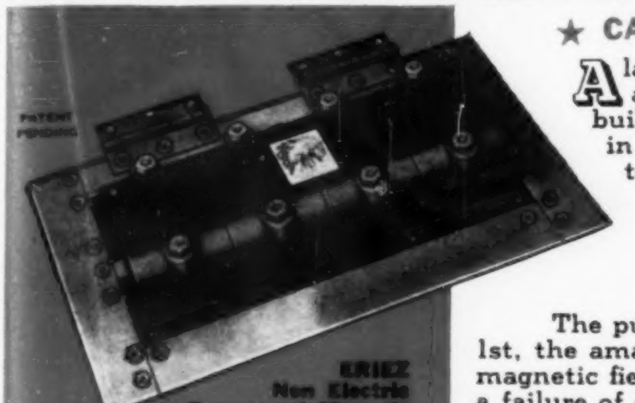
PAINT, PAINTINGS AND RESTORATION. Second edition. *By Maximilian Toch. Published by D. Van Nostrand Co., Inc., N. Y. 149 pages. Price $5.*

Reviewed by C. P. Morrison

THIS is a second edition of the book first published in 1931. Dr. Toch has revised and enlarged his first edition in the light of the many new discoveries and inventions relating to pigments and paintings. In his preface he states that the book is intended for the artist, the manufacturer and the student. He has things of interest and of value to say to each if not to all of them. A number of illustrations—photographs and photomicrographs—add emphasis to the discussions.

He discusses the scientific examination of paintings for the purpose of determining their condition and their authenticity and presents material on photography, infrared photography, ultraviolet photography and x-ray. There are several chapters devoted to the varnishes, particularly damar varnish and the newer picture varnishes, lacquers and stand oil. The manufacture of stand oil is discussed in some detail. He also presents material on the methods of restoring paintings and includes a list of varnish solvents. Each solvent listed is

REMOVING IRON AND STEEL TRASH FROM MATERIALS IN PROCESS



★ CASE STUDY No. 1 — Enamel Frit

A large supplier of enameling material a few months ago installed a new electro magnet which they built themselves at a material cost alone of $750.00 in the discharge chute following a Jeffrey Dryer to remove ferrous particles from enamel frit. After testing the power of the Eriez Non Electric Permanent Magnetic Separator, they removed this expensive electro magnet from the chute and replaced it with a 57" Eriez across the discharge chute at a cost of only $415.00.

The purpose of this replacement was two-fold . . . 1st, the amazing power of the Eriez and its permanence of magnetic field immediately removed the hazard involved by a failure of electric current . . . 2nd, the comparatively low initial cost of the complete Eriez installation is a better investment. First Cost is Last Cost . . . No upkeep cost.

Since making the above installation, 16 more Eriez Magnets have been installed in the various enamel manufacturing plants of this organization.

Leading Eriez users in the Chemical Industries are: PLASTICS AND CERAMICS: Durez Plastics & Chemicals, Lapin Products, Inc., Toledo Plastics Co., Ferro Enameling Corp. CHEMICALS AND DRUGS: Dow Chemical Co., E. I. Dupont de Nemours, Kentucky Chemical Industries, Inc., Stauffer Chemical Co., U. S. Industrial Chemical Inc., Monsanto Chemical Co., Tennessee Eastman Corp. FERTILIZERS: Maxton Oil & Fertilizer Co., Erie Reduction Co. GLASS: Owens-Illinois Glass Co., Libby-Owens-Ford Glass Co. PAINT: Sherwin-William Co., The Glidden Co. PAPER AND PULP: West Virginia Pulp & Paper Co., Fox Paper Co. EXPLOSIVES: Hercules Powder. GENERAL: Congoleum Nairn Inc., Armstrong Cork Co., Johns-Manville, Proctor & Gamble, Standard Dyewood Co., The Carborundum Co., Raybestos-Manhatten, Makalot Corp., Corson Lime Mfg. Co., Phosphate Mining Co.

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LIQUIDS — MAGNESIUM
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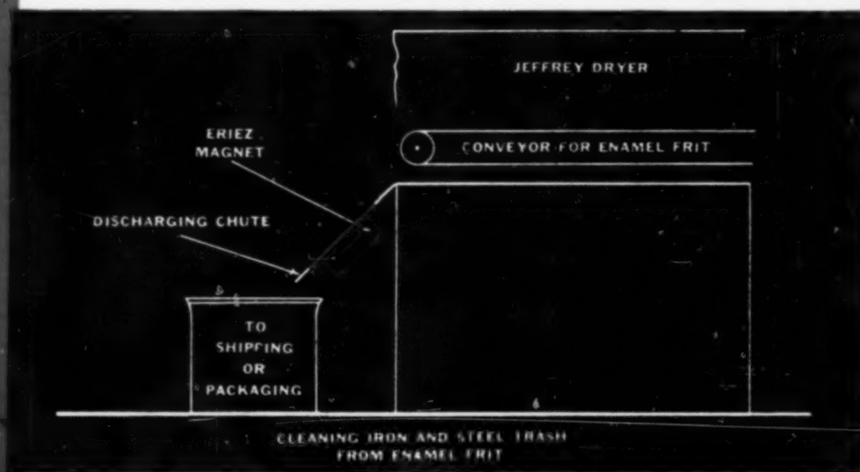
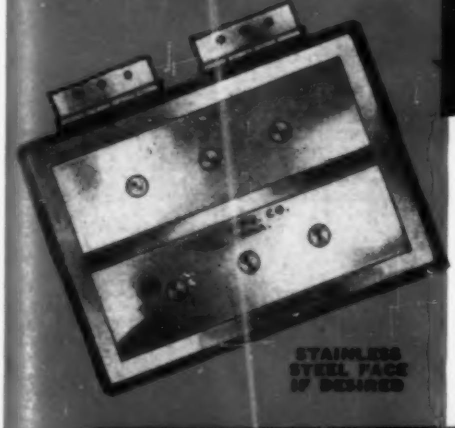
PULP SULPHATE
PULP SULPHITE
RAW SUGAR — RUBBER
SALT — SLUDGE
SOAP — SOYBEAN OIL
SULPHUR



CLEANING IRON AND STEEL TRASH FROM ENAMEL FRIT



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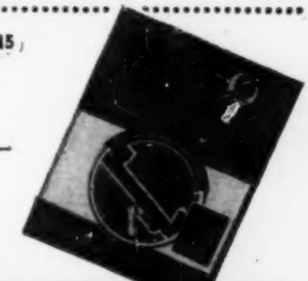

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described as to its peculiarities and its effectiveness.

There is also a list of pigments and the composition and the permanency of each is noted. This list, combined with the palette which Mr. Toch devised for his own students should be a source of information and pleasure to all painters. Manufacturers will be interested in the tables of the pigment content of oil-pigment pastes, of bulking averages of paint liquids and the bulking averages of dry pigments.

In the light of all of this excellent material it is easy to share the author's impatience with those deluded souls who moan that the pigments of the present day are the cause of rapid deterioration of oil paintings and that the colors of the old masters insured permanence. To the contrary we know all that the old masters knew and more too. Undoubtedly Leonardo would have given his eye teeth for a dozen tubes of our permanent colors.

For those who wish to inquire further into specific subjects mentioned there are footnotes giving sources and other references as well as a sizable bibliography.

GOVERNMENT PUBLICATIONS

The following recently issued publications are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publication noted in this list always give the complete title and the issuing office. Remittances should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper covers unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the bureau responsible for its issue.

Aircraft Metals. Navy Training Courses unnumbered document. Bureau of Naval Personnel. Price 30 cents.

Reduction of Iron Ore in Clay and Steel Containers (Saggers). By J. P. Walker. Bureau of Mines, Report of Investigations R. I. 3819. Mimeographed.

Determination of Metallic Iron and Oxygen in Sponge Iron. By J. P. Morris. Bureau of Mines, Report of Investigations R. I. 3824. Mimeographed.

The Industrial Utilization of a Sand-Clay Mixture from Falls and Robertson Counties, Tex. By E. C. Hoeman, R. C. Redfield, and W. C. Stoecker. Bureau of Mines, Report of Investigations R. I. 3825. Mimeographed.

Use of Salts to Allay Dust on Shuttle-Car Roadways in Coal Mines. By Edward Thomas and Irving Hartmann. Bureau of Mines, Report of Investigations R. I. 3828. Mimeographed.

World Survey of Tantalum Ore. By James S. Baker. Bureau of Mines, Information Circular I. C. 7319. Mimeographed.

Destruction of Damaged, Deteriorated, or Unwanted Commercial Explosives. By R. D. Leitch and P. R. Moyer. Bureau of Mines, Information Circular I. C. 7335. Mimeographed.

Shaft Sinking by Rotary Drilling. By D. H. Platt. Bureau of Mines, Information Circular I. C. 7336. Mimeographed.

Typical Analysis Bituminous Coals, District 9 (Western Kentucky). Bureau of Mines. Price 20 cents.

A Handbook on Wage Incentive Plans. War Production Board. Price 10 cents.

Handbook of Descriptions of Specialized Fields in Chemistry and Chemical Engineering. War Manpower Commission. Price 30 cents.

Irrigation Water Requirements. Columbia Basin Joint Investigations. Problems 4 and 5. Bureau of Reclamation. Price 30 cents.

Animal and Vegetable Fats and Oils, 1940-44. Bureau of the Census. Price 10 cents.

Sulfite Pulping of Western Red Cedar. By E. L. Keller and J. N. McGovern. R1494. Forest Products Laboratory, Madison, Wis. Mimeographed.

Effect of Resin Treatment and Compression Upon the Properties of Wood. By R. M. Seborg and Alfred J. Stamm. No. 1383. Forest Products Laboratory, Madison, Wis. Mimeographed.

List of Publications on Mechanical Properties and Structural Uses of Wood and Wood Products. No. R200. Forest Products Laboratory, Madison, Wisconsin. Mimeographed.

List of Publications on Glue and Plywood. No. R513. Forest Products Laboratory, Madison, Wisconsin. Mimeographed.

Lumber Shipped Green Can Be Protected Against Decay. By Carl Hartley. Forest Pathology Special Release No. 26. Joint publication of Bureau of Plant Industry and Forest Service. Forest Products Laboratory, Madison, Wis. Mimeographed.

A Method of Rating Fumigation Chambers for Tightness. By Robert D. Chisholm and Louis Koblitsky. Bureau of Entomology and Plant Quarantine. ET-224. Mimeographed.

Labeling Insecticides Containing DDT. (Revised). Production and Marketing Administration, U. S. Department of Agriculture. Unnumbered mimeographed.

Marketing Activities. Production and Marketing Administration, U. S. Department of Agriculture. Unnumbered mimeographed.

Some Soil Properties Related to the Sodium Salt Problems in Irrigated Soils. Department of Agriculture. Technical Bulletin 902. Price 10 cents.

Poison-Ivy, Poison-Oak, and Poison Sumac: Identification, Precautions, Eradication. By Donald M. Crooks. Department of Agriculture. Farmers' Bulletin No. 1972. Price 10 cents.

Vitamin A in Butter. Department of Agriculture. Miscellaneous Publication No. 571. Price 10 cents.

Fishery Resources of the United States. Fish and Wildlife Service. Senate Document No. 51. Price 40 cents. Elaborate well-illustrated quarto reference book.

Flood of July 5, 1939 in Eastern Kentucky. Part 2 of Notable Local Floods of 1939. By Floyd F. Schrader. Geological Survey Water-Supply Paper 967-B. Price 10 cents.

Water Levels and Artesian Pressure in Observation Wells in the United States in 1943. Part 6. Southwestern States and Territory of Hawaii. By O. E. Meinzer, L. K. Wenzel and others. Geological Survey Water-Supply Paper 991. Price 50 cents.

Production of Sponge Iron in a Shale-Brick Plant. By Donald W. Ross. Bureau of Mines. Report of Investigations R. I. 3822. Mimeographed.

Report on Oxygen-Acetylene Welding and Brazing in Automotive Repairs. Office of Defense Transportation. Unnumbered pamphlet. Price 10 cents.

Facts for Industry—Index of Publications. A mimeographed list which indicates the available statistical statements issued by the Bureau of the Census currently. Includes lists of statements on chemicals and related industrial materials.

Imports of Coal-Tar Products. Chemical Division, U. S. Tariff Commission. Mimeographed. Summary of imports entering the United States during 1944.

Imports for Consumption of Dyes, Aromatic Chemicals, Medicinals, Intermediates, and Other Coal-Tar Products. October-December, 1941. U. S. Tariff Commission. Mimeographed.

Captured Enemy Documents on Petroleum. Microfilm reproductions of captured documents bearing on petroleum technology of Germany

are to be distributed by Library of Congress and about 30 cooperating libraries. Information available through Petroleum Administration for War, Interior Department, or from Library of Congress, Washington. Films may be consulted soon but duplicates for sale may not be promptly available.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog have been issued on the following items: Drums; Steel, Type 5B (for Liquid Petroleum Products) RR-D-729a. Thinner; Paint, Volatile Mineral Spirits (Petroleum-Spirits) TT-T-291a. Oil; Cutting, Mineral-Fatty-Oil-Blend VV-O-251a. Acid, Sulfuric, Technical-Grade O-A-115. Base; Oil, Cutting, Sulfur and Chlorine Containing VV-B-136. Oil; Cutting, Sulfurizd-Fatty-Mineral VV-O-275. Packing; Fiber, Hard, Sheet HH-P-91a. Price 5 cents each.

RECENT BOOKS and PAMPHLETS

Bibliography of References to the Literature on the Minor Elements and Their Relation to Plant and Animal Nutrition. By L. G. Willis. Available from Chilean Nitrate Educational Bureau, 120 Broadway, New York. 103 pages. Sixth supplement to the third edition.

Official Publication. Published by Publications Committee, Technical Societies Council of the Kansas City Area, 4049 Pennsylvania Ave., Kansas City, Mo. 12 pages. Vol. I, No. 1 of an as yet unnamed official monthly publication.

Will Negroes Get Jobs Now? By H. R. Northrup. Pamphlet No. 110, published by Public Affairs Committee, 30 Rockefeller Plaza, New York 20, N. Y. 30 pages. Price 10 cents. The problem and suggested measures which are imperative to prevent disastrous unemployment among Negroes.

Organization of Technical Research in Industry. Prepared by Industrial Research Institute, 60 East 42nd St., New York 17, N. Y. 15 pages. Gratis. A monograph outlining the organization of an industrial research laboratory.

Lessons in Arc Welding. Second edition. Published by the Lincoln Electric Co., Cleveland 1, Ohio. 176 pages. Price 50 cents. Sixty-one lessons with 200 illustrations to supplement the text. Practical instruction based on experiences in the Lincoln Arc Welding School.

The Businessman's Manual of Obligations and Legal Liabilities to Veteran Employees. By H. S. Minot and L. Zasloff. Published by Arco Publishing Co., 480 Lexington Ave., New York 17, N. Y. Price $1.

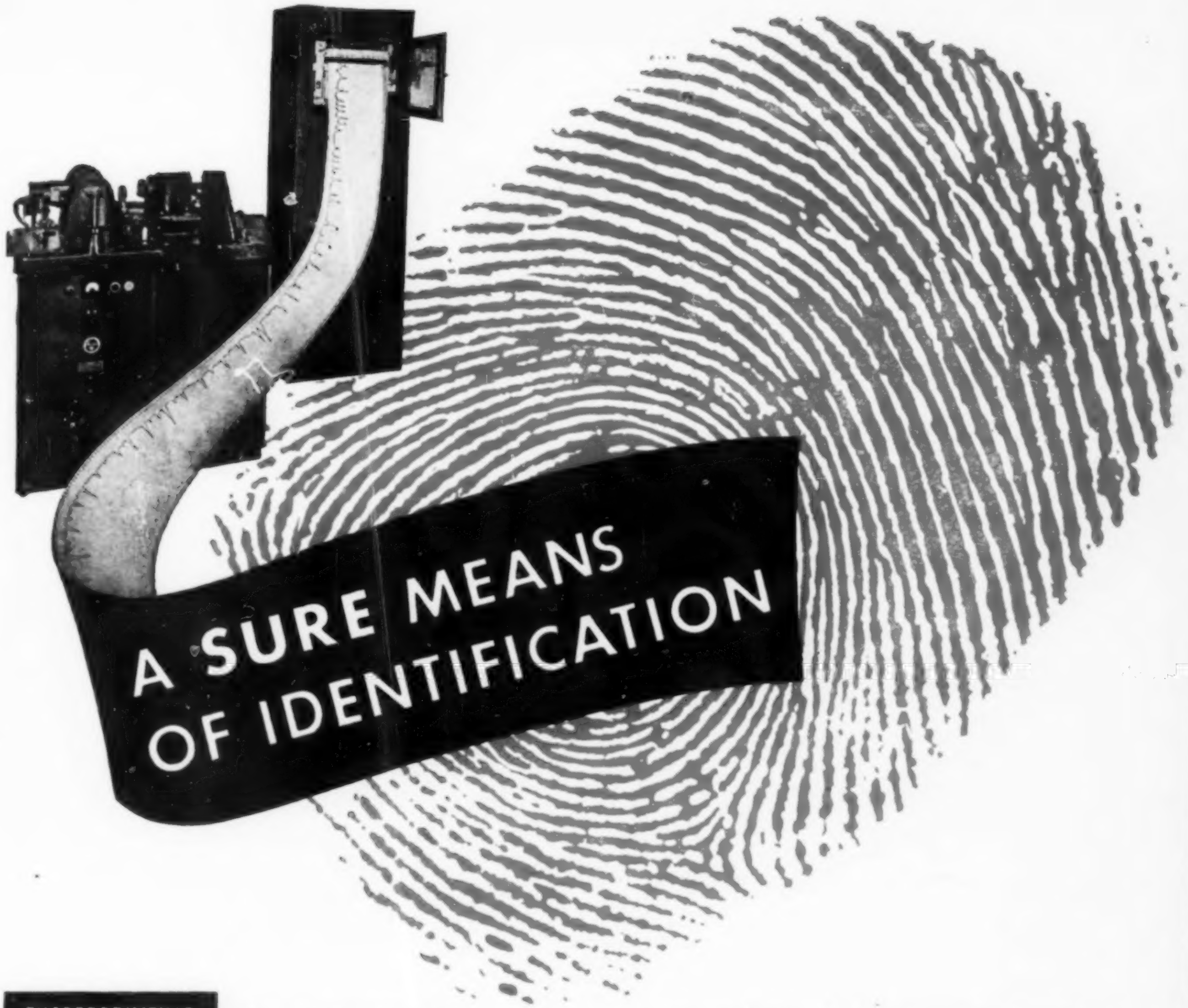
Postwar Economic Studies. Published by Board of Governors of the Federal Reserve System, Washington 25, D. C. Price $1.25. Eight pamphlets dealing with major economic problems of the postwar scene.

Calculation of Static Pressure Gradients in Gas Wells. By M. J. Rzasa and D. L. Katz. Available from Clark Bros. Co., Inc., Olean, N. Y. 14 pages. Reprint of Technical Publication No. 1814 of American Institute of Mining and Metallurgical Engineers.

Tables of Associated Legendre Functions. Prepared by Mathematical Tables Project under sponsorship of National Bureau of Standards under auspices of WPA and OSRD. Published by Columbia University Press, New York. 306 pages. Price $5. Six significant figures at intervals of 0.1. The functions $P_n^m(x)$, $Q_n^m(x)$, and their first derivatives tabulated for integral and half-integral values of n, and integral values of m, and real and imaginary values of x. Functions $P_n^m(\cos\theta)$ and their first derivatives with respect to θ are also tabulated for integral values of n and m.

Commercial Fertilizers and Agricultural Minerals, 1944. Published by Bureau of Chemistry, Dept. of Agriculture, State of California, Sacramento, Calif. Special Publication No. 208. 94 pages. Statistical data on commercial fertilizers and agricultural minerals in California for 1944. Includes figures on consumption by types and years and analyses made by the state laboratory. Lists fertilizer and agricultural minerals registrants and registered jobbers.

New Products. Published by Industries Dept., Portland Chamber of Commerce, Portland 4, Ore. 6 pages. List of industrial products, including many chemicals, which might be made in the Portland area that are not now being manufactured there or not made in sufficient quantity to supply the local market. Based on a survey among purchasing agents of the area.



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MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterheads.

Alloys. Ampco Metal, Inc., 1745 South 38th St., Milwaukee 4, Wis.—Bulletin W-7 describes Phos-Trode shielded arc phosphor bronze weld-rod. Bulletin No. 58 describes and illustrates the use of Ampco metal for die service.

Blowers. Michiana Products Corp., Michigan City, Ind.—Bulletin 45. 4-page illustrated booklet featuring this company's fans for high-temperature applications.

Brick and Tile Machinery. International Clay Machinery Co., 15 Park Row, New York 7, N. Y.—Catalog No. 55. 32-page illustrated booklet describing the various types of equipment used in this work, including clay feeders, conveyors, crushers, pug mills, tile presses, kilns, etc.

Coatings. Nuodex Products Co., Inc., Elizabeth, N. J.—Booklet entitled The Qualitative and Quantitative Determination of Drying Metals in Driers and Surface Coatings.

Compressors. Clark Bros. Co., Inc., Olean, N. Y.—18-page booklet illustrating and describing the cycling plant operated by the Texas Co. at Erath, La. This booklet features the use of compressors at this plant.

Condensers. Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo 13, N. Y.—Bulletin No. 4609. 2-page illustrated folder featuring countercurrent metric condensers with non-clogging spray nozzles. Includes data on materials of construction, size, selection, condensing water requirements, and gives tables and sketches showing the dimensions for various models. Bulletin No. 4509. 2-page leaflet features the parallel flow barometric condensers made by this company. Includes engineering data, sizes and capacities, and dimensions of the various models.

Conveyors. National Conveyors Co., Inc., 50 Church St., New York 7, N. Y.—Three booklets illustrating and describing the equipment manufactured by this company, including ash conveyors, fly ash removal and cinder reburning, industrial and power plant vacuum cleaners, chip conveyors, pneumatic conveyors, mechanical conveyors, furnace drawers, hoppers and gates, and abrasive resistance metals. Application diagrams of various conveyor systems are given.

Detergents. Pennsylvania Salt Mfg. Co., Philadelphia, Pa.—4-page leaflet describing the applications and properties of Pensal for use in laundries.

Dyes. Calco Chemical Div., American Cyanamid Co., Bound Brook, N. J.—Bulletin No. 770. This booklet discusses the microscopical technique for the study of dying. It covers the various techniques in the preparation of microscopical cross-sections and describes methods of color photomicrography.

Electric Controls. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago, Ill.—4-page folder illustrating and describing switch mechanisms for operating indoor rotating insulator switches. Publication No. 4508.

Electrical Insulation. William Brand & Co., 276 Fourth Ave., New York 10, N. Y.—32-page reference manual on electrical insulating materials covering such subjects as theory and behavior of dielectrics, and giving data on such insulating materials as varnishes, gums and plastics, lacquers, as well as inorganic insulation. Includes tables of mechanical and electrical properties of plastic materials, as well as a table of properties of other insulating materials, such as paper, silk, cotton, etc.

Fatty Acid Separation. Blaw-Knox Div. of Blaw-Knox Co., Pittsburgh, Pa.—Bulletin 2051. 24-page booklet illustrating and describing the Emersol process for the separation of fatty acids. Contains detailed process data, discusses the preparation of feed stock for this process,

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and gives plant operating data. A section of the book gives a list of industrial applications, together with typical plant layout, and various charts, tables and graphs pertinent to the process.

Filters. Hercules Filter Corp., Paterson, N. J. —16-page booklet featuring the filter equipment offered by this company. Illustrates and describes the application of various filters and includes sketches to show principles of operation.

Filters. Oliver United Filters, Inc., 33 W. 42nd St., New York 18, N. Y.—4-page illustrated leaflet featuring the filters and pumps manufactured by this company.

First Aid Equipment. The Boyer-Campbell Co., 6540 St. Antoine, Detroit 2, Mich.—6-page leaflet describing SuperSight magnifying lens and light which may be used to aid in the removal of foreign bodies from eyes, of splinters from fingers, for drilling surgery, etc.

Flexible Metal Hose. Pennsylvania Flexible Metallic Tubing Co., 72nd & Powers Lane, Philadelphia 42, Pa.—Bulletin No. 55-G. 8-page booklet illustrating and describing the uses for flexible all-metal hose in handling tank car shipments of liquids and gases.

Flexible Shafting. S. S. White Dental Mfg. Co., Industrial Div., 10 East 40th St., New York 16, N. Y.—256-page book entitled Flexible Shaft Handbook, 2nd edition, covering essential information and data about flexible shafts. This book is divided into three main sections covering power drive, remote control, and design of combinations. Each of these sections is well illustrated and covers such subjects as applications, casing, typical combinations, data sheets, and shaft data table. A 25-page appendix provides tables of engineering data. This handbook for ready reference should be invaluable to any user of flexible shafting.

Fluorescent Lamps. Westinghouse Electric & Mfg. Co., Bloomfield, N. J.—16-page booklet illustrating and describing the principles of fluorescent lighting.

Forgings. Kropp Forge Co., 5301 W. Roosevelt Road, Chicago 60, Ill.—32-page booklet entitled Glossary of Machine Shop Terms, which should be interesting and useful to any engineer not familiar with terms used in heavy machine shop practice.

Friction Materials. The General Metals Powder Co., 130 Elinor Ave., Akron 5, Ohio—4-page illustrated folder describing various types of compressed metallic friction materials manufactured by this company.

Industrial Tires. B. F. Goodrich Co., Akron, Ohio—38-page illustrated booklet discussing the use of tires on industrial trucks. Specifications of the various types of tires are given, as well as a discussion of care and maintenance of these tires. Several pages are devoted to specifications for a partial list of power trucks and tractors, with the model, type, capacity, and tire sizes listed.

Insecticides. Geigy Co., Inc., 89-91 Barclay St., New York 8, N. Y.—32-page translation entitled "The Constitution and Toxi Effect of Botanicals and New Synthetic Insecticides."

Instruments. Micro Switch, Freeport, Ill.—2-page leaflet describing the use of micro switch snap-acting switch for temperature controls.

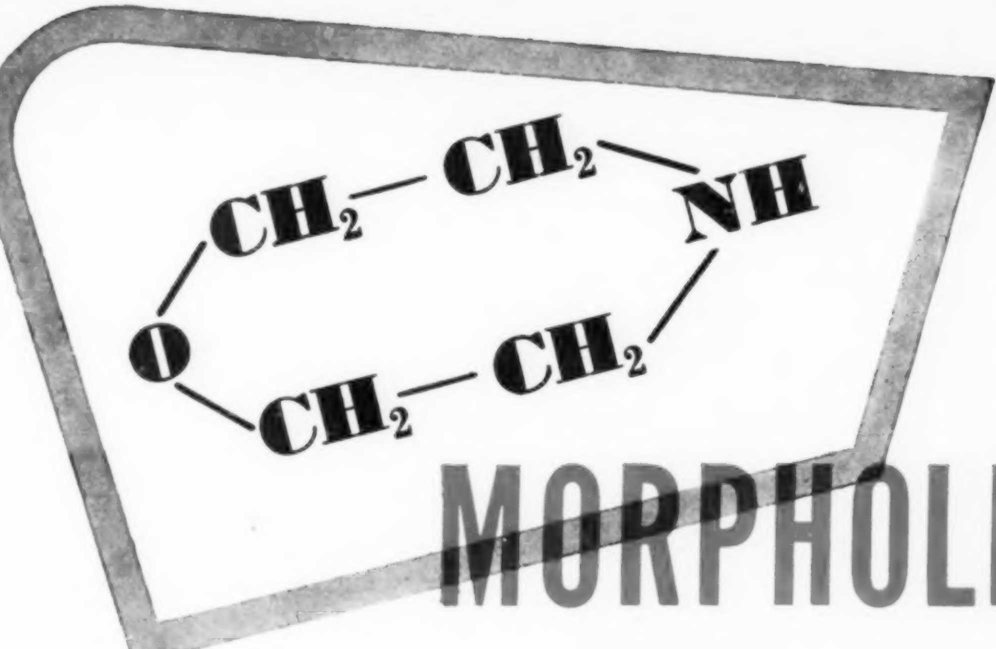
Instruments. National Technical Laboratories, South Pasadena, Calif.—Several bulletins describing pH equipment made by this company. Included are Bulletins Nos. 86, 16, 93A, 94A, 134, 21A, 31, and 92.

Instruments. Taylor Instruments Cos., Rochester 1, N. Y.—Catalog 300. 36-page catalog featuring instruments for refrigeration control. The application of instruments to refrigeration are discussed and illustrated with sketches of control systems. Features and specifications of the various instruments and accessory equipment are included.

Instruments. Wheelco Instruments Co., Chicago 7, Ill.—Bulletin S2-6. 32-page thermocouple data book and catalog which describes, gives lists prices and makes recommendations for thermocouples, thermocouple wire, lead wires, heads, connectors, plug and socket assemblies, insulators and protecting tubes.

Insulation. Illinois Clay Products Co., Joliette, Ill.—2-page leaflet describing Therm-O-Flake high-temperature insulation for use in open-hearth and blast furnaces and other equipment operated at high temperatures. Also describes the various kinds of fire clay products made by this company.

Leather Packing. Alexander Bros., 406 N. 3rd St., Philadelphia 23, Pa.—4-page leaflet featuring the leather packing manufactured by this company. Discusses packing selection and de-



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ORGANIC SYNTHESIS

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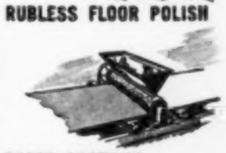

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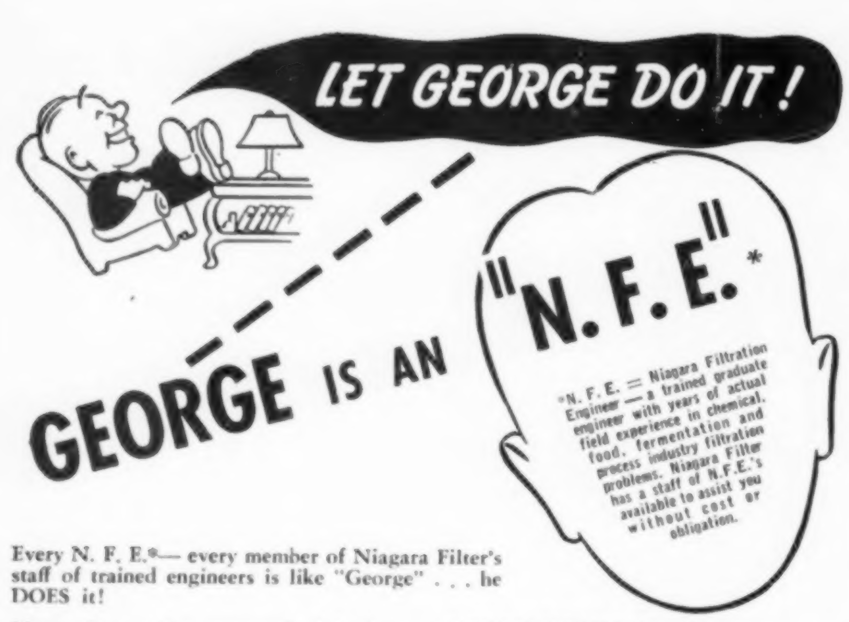
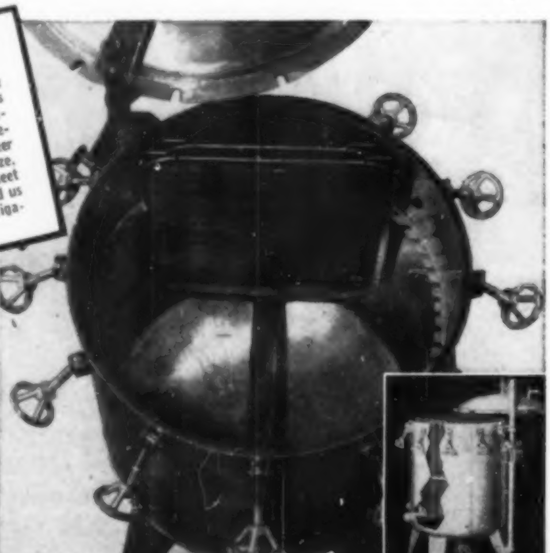




scribes some of the main types of packing made by this company. Price lists are included.

Management Engineering. Methods Engineering Council, 822 Wood St., Pittsburgh 21, Pa.—20-page brochure describes in detail the functions of modern management engineering. Contains a section on general management services and discusses methods engineering, training, plant layout design, job evaluation, wage incentive plans and personnel appraisal.

Materials Handling. Crescent Truck Co., Lebanon, Pa.—4-page illustrated leaflet describing the Crescent electric Palletier forked truck. The main features of the truck are described and illustrated and specifications are also given.

Materials Handling. Harnischfeger Corp., Milwaukee 14, Wis.—Bulletin C9-1. 28-page booklet describing P & H grab bucket cranes for service in handling all types of bulk materials. Construction details are given 'and various industrial applications illustrated.

Oxygen Chemicals. Buffalo Electrochemical Co., Inc., Buffalo 7, N. Y.—Pocket size folder describing the active oxygen chemicals produced by this company. Includes properties and suggested uses, as well as the percent by weight of active oxygen for such chemicals as hydrogen peroxide, potassium persulphate, ammonium persulphate, sodium pyrophosphate, peroxide, and others.

Packaging. Weatherproof Solid Fibre Box Group, 735 Eleventh St., N.W., Washington 1, D. C.—16-page brochure prepared by the Container Testing Laboratories, Inc., which discusses the quality and performance of Vs boxes used extensively to pakage war materials. The quality tests made on these boxes to insure high quality are described in detail.

Penicillin. Heyden Chemical Co., 393 Seventh Ave., New York 1, N. Y.—12-page illustrated brochure featuring the production of penicillin by this company.

Petroleum Products. Standard Oil Co. of Ind., Chicago, Ill.—84-page engineering bulletin discussing the correct selection and application of petroleum products for industrial diesel engines. Complete information on engine design, fuel systems, combustion chamber design, lubrication systems, and other data are given. Includes information on diesel fuels and engine lubricating oils.

Petroleum Refining. The Lummus Co., 420 Lexington Ave., New York 17, N. Y.—60 page brochure entitled Petroleum Refining Processes contains data on catalytic cracking, polyforms, lubricating oil, solvent refining and dewaxing, and other petroleum chemical processes. Included are 22 full-page flow charts of latest refinery processes and installation data on certain equipment made by this company.

Pipe and Conduit. The Fibre Conduit Co., Orangeburg, N. Y. Catalog No. 304. 40-page illustrated book features Orangeburg fibre pipe and its various applications. Application and installation diagrams are included. Catalog No. 49. 20-page booklet describes Orangeburg fibre conduits for cable protection. Specifications together with installation and application data are included.

Pipe Hangers. Blaw-Knox Co., Power Piping Div., Pittsburgh, Pa.—Catalog 2026. 34-page illustrated booklet featuring the functional spring hangers and vibration eliminators designed to carry the dead weight of the pipe, eliminate vibration, and absorb shock. Includes details concerning standard and special types and sizes of this equipment, together with instructions for installation, and engineering information.

Plastics. Durite Plastics, 5000 Summerdale Ave., Frankford Station P. O., Philadelphia, Pa. Bulletin No. 24—8-page booklet describing Durite resins for plaster-of-paris induration. Both aminoplast and resorcinal resins are discussed, with information being given on curing, physical properties, mixing formulae, etc.

Power Transmission. Chain Belt Co., Milwaukee, Wis.—Bulletin No. 45-1. 8-page folder describing Baldwin-Rex roller chain belt for power transmission. Features of this roller chain together with roller chain shaft couplings are discussed, and specifications showing sizes, model numbers, and list prices are given. Bulletin 455. 12-page illustrated booklet describing the chain belts and portable pumps used in oils field service. Specifications, dimensions and price lists are given.

Power Transmission. Union Chain & Mfg. Co., Sandusky, Ohio—Bulletin FC1. 16-page catalog featuring flexible couplings manufactured by this company. Specifications, ratings, dimensions and list prices are given in table form. Catalog A2. 146-page pamphlet giving information on both the drive and conveyor chains

furnished by this company. Catalog C2. 176-page catalog of steel roller chains and sprockets. The bulk of the book is devoted to tables showing specifications, dimensions, weights, list prices, and engineering data.

Precious Metals. Baker & Co., Inc., Newark, N. J.—8-page brochure featuring this company's products and facilities for refining and working precious metals.

Process Equipment. Artisan Metal Products, Inc., 211 Congress St., Boston 10, Mass.—12-page illustrated booklet featuring the process equipment manufactured by this company. Includes data on such equipment as autoclaves, reactors, jacketed kettles, industrial piping, condensers, stills, heat exchangers, evaporators, etc.

Process Equipment. Ingersoll-Rand Co., Phillipsburg, N. J.—Form 122. 16-page illustrated booklet describing equipment for chemical and process plants, including compresses, vacuum pumps, blowers, centrifugal pumps, ejectors, condensers, engines and air tools.

Protective Coating. Bakelite Corp., 300 Madison Ave., New York 17, N. Y.—Booklet E-7. 22-page illustrated brochure describing protective coating based on Bakelite resins. Various resins used for coatings are described and applications are shown. Includes a table giving properties and characteristics of Bakelite resins used for coating purposes.

Pumps. Byron Jackson Co., Box 2017, Terminal Annex, Los Angeles, Calif.—72-page brochure entitled Horizons, which gives a history of the development of this company's pump manufacturing business. Some of the important present-day applications are outlined.

Pumps. Kinney Mfg. Co., Washington St., Boston 3, Mass.—Bulletin V45. 24-page illustrated booklet featuring the high-vacuum pump made by this company. Principles of operation are described, types of equipment are illustrated, formulae for selecting vacuum pumps are shown, and tables of engineering data are included.

Pumps. Milton Roy Pumps, 1300 E. Mermaid Ave., Philadelphia 18, Pa.— Technical Paper No. 51. 8-page reprint discussing chemical feed systems for water treatment.

Rubber Compounding Agent. Marbon Corp., 1926 W. Tenth Ave., Gary, Ind.—13-page booklet describing Marmix, a reinforcer for synthetic rubber latices.

Silicones. Dow Corning Corp., Midland, Mich. 12-page booklet describing the various uses of silicone compounds. This includes a discussion of the various types of silicone lubricants, heat transfer fluids, varnishes and resins. Tables are included which give the properties and characteristics of the different materials.

Sludge Treatment. Ansul Chemical Co., Marinette, Wis.—Form 45105.—8-page pamphlet discussing the work carried out by this company in the study of sludges occurring in refrigeration systems.

Steel Shafting. De Laval Steam Turbine Co., Trenton, N. J.—16-page booklet containing data in the form of tables and graphs which is useful for determining stresses, torques, bending moments and deflections in steel shafting. Bulletin WG 545.

Storage Bins. The Ness & Fry Co., Camden, Ohio—General industry catalog describing the gravity storage bins furnished by this company. Certain details of construction and layout are shown together with illustrations of typical applications.

Synthetic Rubber. Chicago Belting Co., 113 No. Green St., Chicago 7, Ill.—32-page booklet featuring mechanical molded parts of synthetic rubber. Contains discussions of compounding, extruding, molding, inspection methods, and various types of molded products.

Thawing Pits. Hauck Mfg. Co., 125 Tenth St., Brooklyn 15, N. Y.—Bulletin No. 1040. 4-page leaflet describing thawing pits for unfreezing wet coal and other materials transported in hopper cars. Discusses the radiant method of heating coal hoppers which avoids direct flame contact.

Water Treatment. Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia 32, Pa.—Bulletin 4181. This bulletin describes the process of preparing clear water, the equivalent of commercially distilled water, by ion exchange demineralizers. Chemical reactions of the ion exchange process are given.

Zinc Products. Whitex Products Div., White Metal Rolling & Stamping Corps., 80 Moultrie St., Brooklyn 22, N. Y.—4-page leaflet describing extruded zinc products which include pure zinc anodes in a wide variety of diameters and lengths.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDUSTRIAL CONSUMPTION OF CHEMICALS INCREASES IN FACE OF GENERAL DOWNWARD TREND

Under the influence of gradually diminishing demand for goods used directly in the war effort, a downward trend for industrial production has been in evidence throughout the present year to date. With the termination of the European phase of the war, the downward movement became precipitous and this trend received further impetus with the closing of hostilities in the Far East. The extent of this decline is definitely shown by the Federal Reserve Board's indexes for industrial production which stood at 230 in January with the preliminary figure for October placed at 166.

Just as the unprecedented demand for all types of war materials pushed the production index up to abnormally high levels throughout the war period, in almost equal measure the elimination of such requirements has brought the index back to a point almost identical with that reported for the final quarter of 1941. An appreciable segment of this curtailment of output, represented by tanks, jeeps, ships, planes, guns and high explosives, is of a permanent nature. It will be offset to a large degree through the adaptation of plants to a peacetime economy but progress along that line has been slowed by material shortages, labor troubles, delays in reconversion, and the preference shown by former war workers to take long vacations under the protection of unemployment compensation.

In the face of the declining trend in general industry, consumption of chemicals in regular manufacturing channels has made a splendid showing. It is true that some of the chemicals classified as industrial found their end use in products which were absorbed somewhere in the war effort and the termination of the war cut off such outlets. However, the *Chem. & Met.* index for industrial consumption of chemicals moved against the general trend in October and advanced to 194 as compared with a revised figure of 184 for September. The rise was largely due to enlarged activities in rayon, pulp and paper, and textiles. However, superphosphate production which carries a very heavy weighting in the index, was sharply increased in October with total output reported at 731,718 tons on a basis of 18 percent APA. This far exceeds production for any other month of this year.

The Federal Reserve Board index for chemicals which reached its high of 321 last March followed the lead of industrial production from that month on until it stood at 237 for September but a recovery was staged in October with 239 as the index for that month. This index includes related materials as well as chemicals and the board's separate index for industrial chemicals fell to a lesser extent, from a high of 412 in June to a preliminary figure of 367 for October. The index for chemicals naturally reflected the loss in production caused by the closing of some government-operated plants.

A further loss in production of chemicals is indicated by orders issued early in December whereby government plants making butadiene from alcohol are to cease operations. This resulted from a directive requesting that production of synthetic rubber be placed on an economic basis. According to the associate director of the Office of Rubber Reserve the cost of butadiene made from alcohol was about 40c. a lb. and the cost of synthetic rubber made from this butadiene was fractionally higher than 24c. a lb., while butadiene was produced from petroleum at a cost of 8 to 10c. a lb. and the cost of synthetic rubber from this source was 12 to 13c. a lb. The alcohol plants to be closed are at Institute, W. Va., operated by Carbide & Carbon Chemicals Corp., with a capacity of 80,000 tons a year; at Kobuta, Pa., operated by Koppers Co., with a capacity of 80,000 tons a year; and at Louisville, Ky., operated by Carbide & Chemicals Corp., with a capacity of 60,000 tons a year. The latter plant had been closed prior to the issuance of the order. All these plants will be kept in standby condition.

Chem. & Met. Index for Industrial Consumption of Chemicals

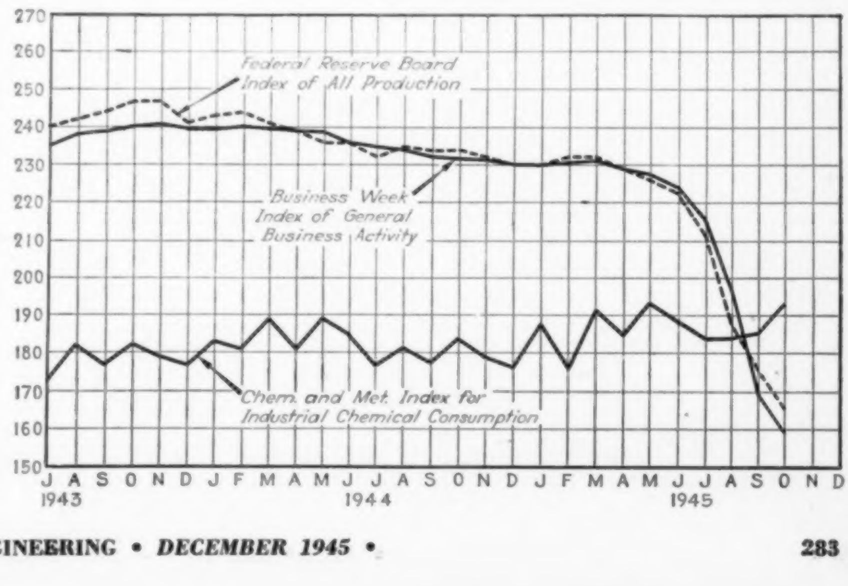
1935 = 100

	Sept. Revised	Oct.
Fertilizers	41.04	46.05
Pulp and paper	18.90	21.20
Petroleum refining	17.03	17.16
Glass	20.05	21.40
Paint and varnish	15.59	16.00
Iron and steel	10.57	10.15
Rayon	17.65	19.72
Textiles	9.56	10.40
Coal products	9.34	9.50
Leather	4.40	4.50
Industrial explosives	5.57	5.66
Rubber	7.80	7.20
Plastics	6.50	6.00
	184.00	194.94

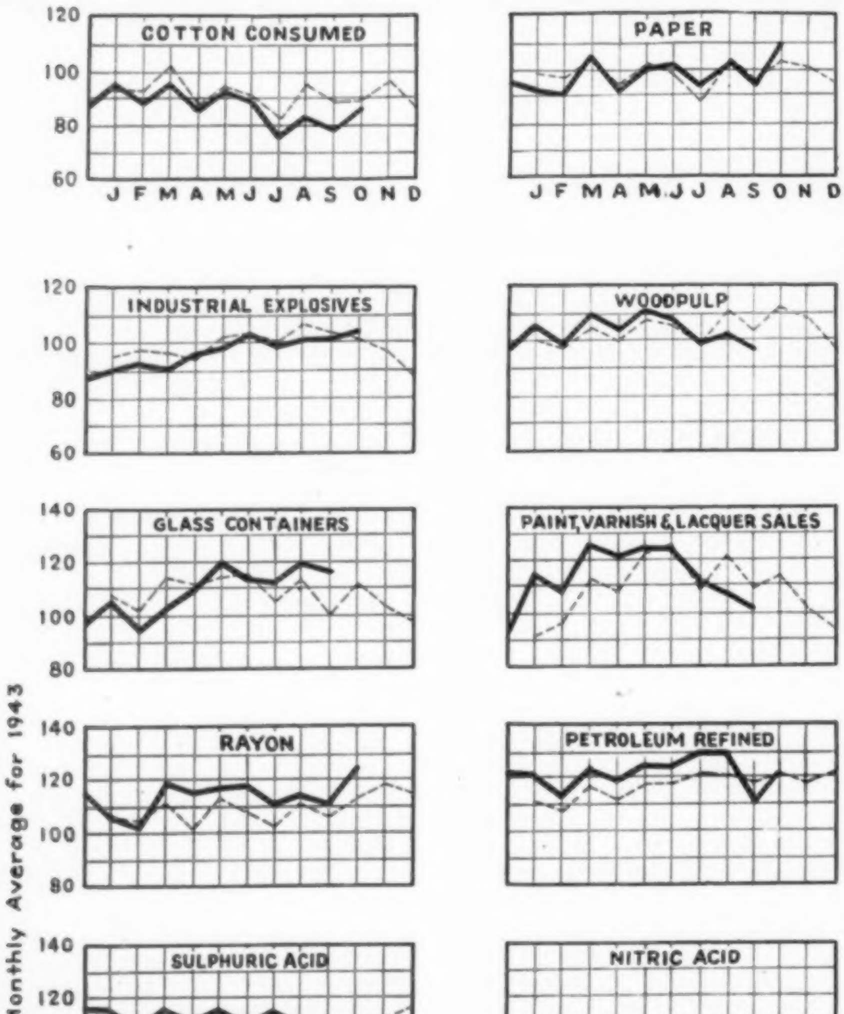
Following the principles of economy, the styrene plants at Institute and Kobuta also are closed. In addition, three oil refineries which had been converted to the manufacture of butadiene are being closed. They are at Ingleside, Tex., operated by Humble Oil & Refining Co.; at Corpus Christi, Tex., operated by the Taylor Refining Co.; and at El Dorado, Ark., operated by the Lion Oil Co. These plants produced only a small part of total output of butadiene and they will be returned to oil refining.

While the cut in production of alcohol is important from the standpoint of total chemical production, it favors a larger consumption in industrial lines. In fact regular consumers have been given larger amounts of alcohol recently as reduced requirements for rubber have made it possible to increase allocations for other use.

The position of synthetic rubber will be important in the chemical picture. Wartime production schedules already have been relaxed and much will depend upon the amount of the natural product which will be available for domestic use. Very few details have been made public about the recent rubber conference in London but some members of the industry hold the view that exports of synthetic may reach 300,000 tons next year and with domestic needs running about 600,000 tons, this would indicate a production figure of about 900,000 tons. Receipts of natural rubber in the year ahead are currently estimated at 300,000 tons.



PRODUCTION AND CONSUMPTION TRENDS



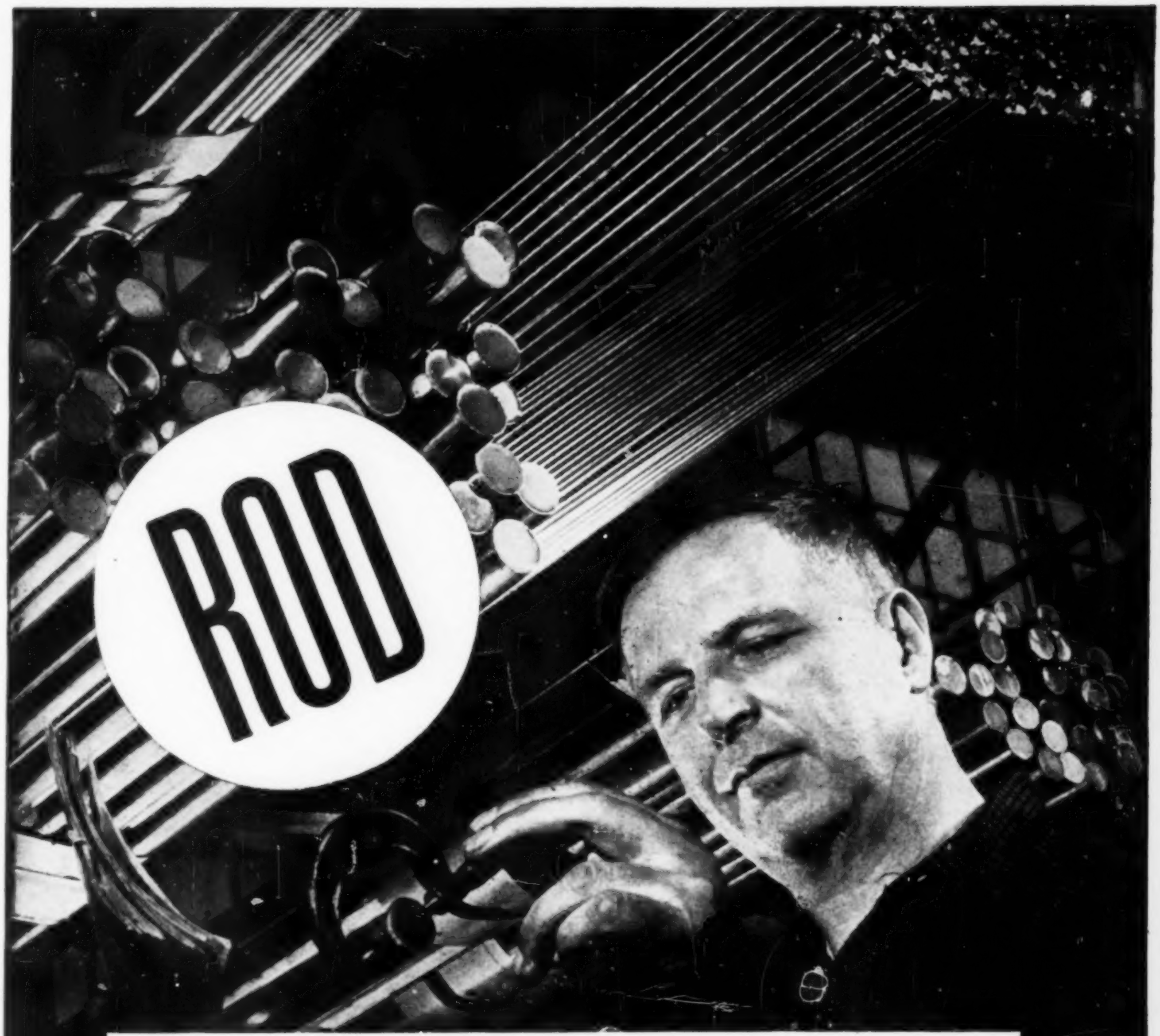
The downward curve for production of chemicals which has been in evidence in recent months was checked in October with some of the finished products gaining back some of the lost ground. However, uncertainty exists regarding the immediate future because of the possibility that some plants may be closed due to labor troubles. Closing of plants already has added to the shortage of some materials and prevented production in general from reaching higher levels. While the automotive plants have felt the impact of strikes in their own factories, they also have been affected by reduced operations at works which furnish them with important materials. For instance, a curtailment of plate glass production has cut down the supply of glass and even forced the recall of stocks from dealers.

In very few cases has there been any real inroad made on the backlog of consumer demands and the potential field for practically all lines of manufacture remains far above what is regarded as normal. Hence, the removal of present obstacles will still find a sellers market for the majority of products. There are some chemicals which offer an exception to this general rule and these are recognized by the easier price tone which rules for those products.

Production of alcohol and some rubber chemicals promises to drop as a result of closing some government plants and a temporary setback in styrene production will result from the fire which, early in December, damaged the alkylation unit of the government-owned styrene plant operated by the Monsanto Chemical Co. at Texas City, Tex. However, there is no shortage of rubber chemicals.

In the chemical-consuming industries, more favorable reports came from steel mills in the final quarter of the year. Production of woodpulp rose sharply in October with the output of 821,149 tons being larger than in any month since June 1942. Paper mills also speeded up activities with an outturn of 647,052 tons for that month. Oil refineries became more active in the latter part of October and while there was a small drop in daily runs to stills in November, the average for that month was high with the total running well ahead of the September and October figures.

The cancellation of government orders has brought about a drop in the movement of paint and varnish but government needs are expected to remain considerably above the prewar standards for a long time to come and civilian needs will swell the total consuming market to a huge tonnage. The chief difficulty confronting paint makers is the limited supply of raw materials. Practically all the pigments are in too short supply to fill all requirements and many of the colors are in a similar position. Linseed oil and other drying oils, however, offer the greatest problem. These oils have been scarce for a long time and the outlook has not improved. Whether linseed oil will prove a bottleneck will depend largely upon the amount of Argentine seed which will come to this country.



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We offer Revere rod in the following:

Copper	**Manganese Bronze**
Free-Cutting Copper	**Herculoy (Silicon Bronze)**
Free-Cutting Brass	**Aluminum Bronze**
Brass (not free-cutting)	**Aluminum-Silicon Bronze**
Red-Brass	**Nickel Silver**
Naval Brass	**Magnesium Alloys**
Muntz Metal	**Aluminum Alloys**
Commercial Bronze	**Special Alloys**
Roman Bronze	

Available in coils or straight lengths, depending on size and composition. For full details, prices and deliveries, consult your Revere Distributor or us. The Revere Technical Advisory Service will gladly work with you in selecting the rod best fitted for your needs. For this assistance, which is given without obligation, just write the nearest Revere Office.

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Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in principal cities, Distributors everywhere

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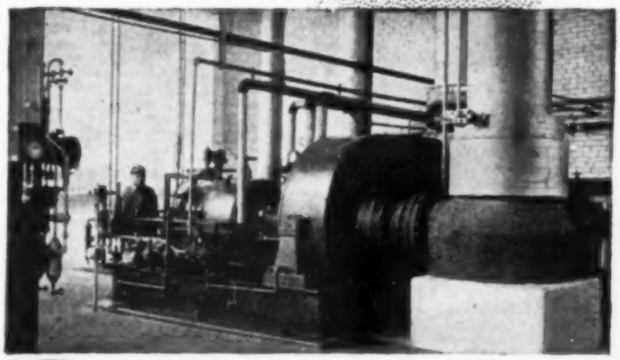
United States Production of Certain Chemicals

September 1945, September 1944 and Nine-Month Totals for 1945 and 1944

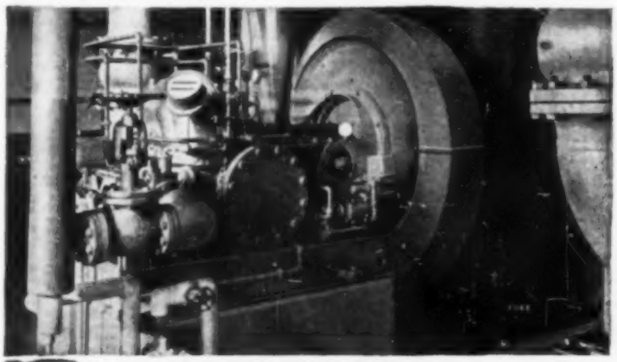
Chemical and Basis	Units	September 1945	September 1944	Total, First 9 Months 1945	Total, First 9 Months 1944
Acetylene:					
For use in chemical synthesis	M cu. ft.	205,784	307,553	3,733,567	3,908,313
For commercial purposes	M cu. ft.	88,348	131,276	1,108,956	1,244,844
Aluminum chloride: Anhy. & crystal (100% $AlCl_3$)	M lb.	3,149	4,805	43,084	43,829
Solution (32° Be)	M lb.	780	1,062	8,581	7,853
Ammonia, synthetic anhydrous (100% NH_3)[1]	Tons	42,685	45,292	419,608	391,412
Ammonium chloride (100% NH_4Cl)	M lb.	5,399	4,733	49,385	42,217
Barium sulphate (Blanc fixe) (100% $BaSO_4$)	M lb.	5,646	4,581	42,094	43,379
Bleaching powder (35–37% avail. Cl_2)	M lb.	1,083	2,528	19,229	39,730
Calcium acetate (80% $Ca(C_2H_3O_2)_2$)	M lb.	566	966	5,721	8,463
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	906	1,130	22,937	40,311
Calcium carbide (commercial)	Tons	45,384	62,591	536,744	583,889
Calcium hypochlorite (true) (70% avail. Cl_2)	M lb.	567	1,173	10,812	10,502
Calcium phosphate: monobasic (100% $CaH_4(PO_4)_2$)	M lb.	4,747	5,139	44,763	44,893
Dibasic (100% $CaHPO_4$)	M lb.	5,873	2,992	35,483	38,221
Carbon, activated	M lb.	5,275	5,129	46,710	45,957
Carbon black (channel): rubber grade	M lb.	45,548	31,380	362,434	277,114
Other than rubber grade	M lb.	3,068	2,358	24,372	20,456
Carbon dioxide: liquid and gas	M lb.	16,454	31,822	161,380	270,267
Solid (dry ice)	M lb.	62,764	64,129	531,178	497,302
Chlorine	Tons	89,600	102,190	916,442	949,645
Chrome green (C.P.)	M lb.	902	577	4,707	4,613
Chrome yellow and orange (C.P.)	M lb.	3,861	2,689	30,184	25,688
Copper acetoarsenite (Paris green)	M lb.	156	460	3,297	3,283
Hydrochloric acid (100% HCl)	Tons	30,852	32,131	318,844	274,367
Hydrogen	M cu. ft.	1,573,000	2,084,000	18,025,000	18,051,000
Hydrogen peroxide (100 volumes)	M lb.	2,659	2,408	23,879	20,855
Iron blue (C.P.)	M lb.	773	714	6,941	6,749
Lamp black	M lb.	1,149	1,017	11,185	10,612
Lead arsenate (acid and basic)	M lb.	2,313	5,753	58,356	68,395
Lead oxide: red (C.P.)	M lb.	7,275	8,625	82,965	77,960
Yellow (C.P.)	M lb.	30,263	39,091	253,707	233,191
Methanol: synthetic (100% CH_3OH)	M gal.	6,112	5,435	56,777	53,395
Molybdate chrome orange (C.P.)	M lb.	218	91	1,205	1,016
Nitric acid (100% HNO_3)	Tons	32,025	39,349	348,435	345,481
Oxygen	M cu. ft.	890,436	1,567,055	11,241,594	14,175,055
Phosphoric acid (50% H_3PO_4)	Tons	63,800	52,039	517,587	526,477
Potassium bichromate and chromate (100%)	M lb.	491	588	4,876	5,698
Potassium hydroxide (100% KOH)	Tons	4,532	3,518	40,673	32,682
Soda ash (commercial sodium carbonate):					
Ammonia-soda process (98–100% Na_2CO_3)					
Total wet and dry[2]	Tons	333,453	365,362	3,258,724	3,415,985
Finished light[3]	Tons	160,528	198,216	1,723,034	1,857,634
Finished dense	Tons	121,594	116,652	1,055,393	1,090,373
Natural[4]	Tons	14,780	14,503	137,632	133,178
Sodium bicarbonate (refined) (100% $NaHCO_3$)	Tons	13,846	12,383	125,261	119,238
Sodium bichromate and chromate (100%)	Tons	6,561	6,289	59,557	61,594
Sodium bisulphite (100% $NaHSO_3$)	M lb.	2,687	3,760	27,031	31,402
Sodium hydrosulphide (100% NaSH)	M lb.	1,940	2,103	19,609	19,846
Sodium hydrosulphite (100% $Na_2S_2O_4$)	M lb.	3,115	3,189	28,086	31,280
Sodium hydroxide (100% NaOH):[5]					
Electrolytic process, liquid	Tons	85,323	99,216	869,052	901,024
Solid	Tons	14,966	....	164,943	....
Lime-soda process, liquid	Tons	54,646	56,023	547,290	510,279
Solid	Tons	18,929	....	180,741	....
Sodium phosphate: monobasic (100% NaH_2PO_4)	Tons	1,003	2,717	10,960	22,278
Dibasic (100% Na_2HPO_4)	Tons	5,014	4,034	44,780	41,167
Tribasic (100% Na_3PO_4)	Tons	7,296	6,005	63,044	58,202
Meta (100% $NaPO_3$)	Tons	2,299	1,761	19,990	19,503
Tetra (100% $Na_4P_2O_7$)	Tons	3,812	3,160	30,213	29,333
Sodium silicate: soluble silicate glass liquid and solid (anhydrous)	Tons	24,804	35,057	325,201	311,308
Sodium sulphate: anhydrous (refined) (100% Na_2SO_4)	Tons	6,691	5,331	57,461	57,985
Glaubers salt (100% $Na_2SO_4 \cdot 10H_2O$)	Tons	13,780	65,209	152,844	598,153
Salt cake (crude) (commercial)[4]	Tons	43,598		409,386	
Sulphur dioxide	M lb.	5,996	6,900	57,576	57,596
Sulphuric acid (100% H_2SO_4):[4] chamber process	Tons	248,657	253,506	2,394,352	2,382,884
Net contact process[6]	Tons	394,160	430,383	4,265,064	3,907,130
White lead: basic lead carbonate (C.P.)	Tons	4,264	....	31,217	....
Basic lead sulphate (C.P.)	Tons	1,052	....	8,933	....
Zinc Yellow (zinc chromate) (C.P.)	Tons	512	....	12,763	....

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred material. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production including quantities diverted for manufacture of sodium bicarbonate and caustic soda and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Includes oleum grades. Excludes spent acid.

Mighty Winds for...



AIR BLOWER — T.C.C. This turbine-driven blower supplies combustion air for regenerating the bead catalyst used in Thermofor Catalytic Cracking plants.



HOT GAS RECIRCULATOR Certain catalytic cracking processes require the recirculation of hot flue gases at high pressures. The unit shown above was developed especially for this service.

AIR BLOWER — FLUID CATALYST This 4300-hp turbine-driven blower supplies combustion air for regenerating the dust catalyst used in Fluid Catalytic Cracking plants.

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Altogether, the powerful Turbo-blowers serving America's catalytic cracking plants could put forth a mighty and victorious blast of air—and in a sense they do just that—by performing their part in the winning of the "octane war."

The expansion of catalytic cracking facilities for 100-octane aviation gasoline found Ingersoll-Rand ready with developed and proven Turbo-blowers. I-R machines with a capacity of more than one and one-quarter million cfm are now meeting the needs of refineries throughout the country.

Certain catalytic cracking processes involved new problems in the handling of gases at high temperatures and pressures, and these have been solved with new designs. This is another example of Ingersoll-Rand service to refineries—a unique service which includes the developing and supplying of Reciprocating Compressors, Turbo-blowers, and Centrifugal Pumps to keep pace with each new demand made by the ever-changing processes of the industry.

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CHEM. & MET.

Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

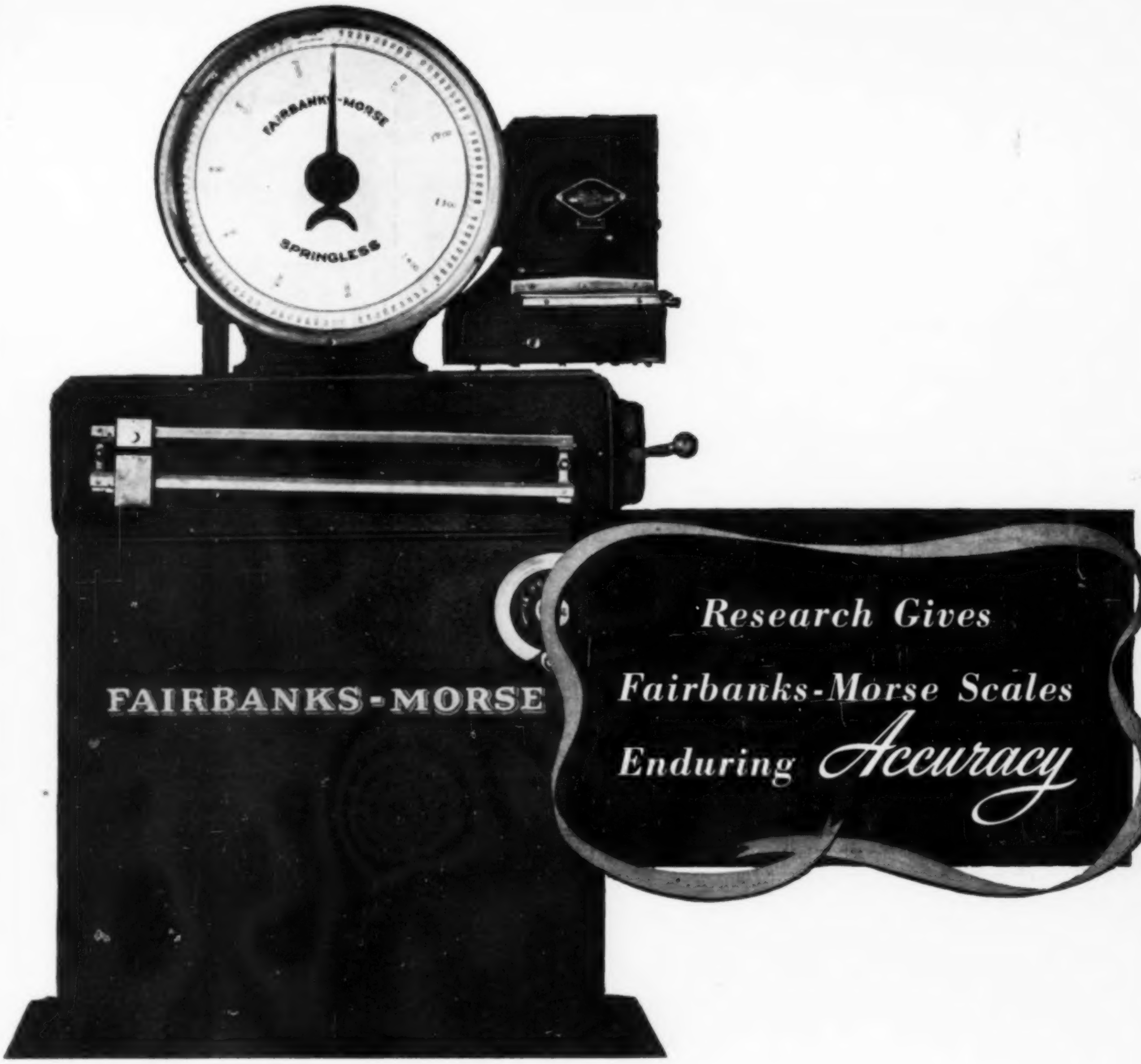
This month	109.08
Last month	108.78
December, 1944	108.31
December, 1943	109.80

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to December 11

INDUSTRIAL CHEMICALS

Acetone, tanks, lb	$0.06 –	......
Acid, acetic, 28%, bbl., 100 lb	3.38 –	$3.63
Boric, bbl., ton	109.00 –	113.00
Citric, kegs, lb	.20 –	.23
Formic, cbys., lb	.10½ –	.11
Hydrofluoric, 30%, drums, lb	.08 –	.085
Lactic, 44%, tech., light, bbl., lb	.073 –	.075
Muriatic, 18°, tanks, 100 lb	1.05 –	......
Nitric, 36°, carboys, lb	.05 –	.05½
Oleum, tanks, wks., ton	18.50 –	20.00
Oxalic, crystals, bbl., lb	.11½ –	.12½
Phosphoric tech., tanks, lb	.04 –	......
Sulphuric, 60°, tanks, ton	13.00 –	......
Tartaric, powd., bbl., lb	.70½ –	......
Alcohol, amyl	... –	......
From pentane, tanks, lb	.131 –	......
Alcohol, butyl, tanks, lb	.10½ –	.18½
Alcohol, ethyl, denatured, 190 proof	... –	......
No. 1 special, tanks, gal	.5e2 –	......
Alum, ammonia, lump, lb	.04½	......
Aluminum sulphate, com. bags 100 lb	1.15 –	1.49
Ammonia, anhydrous, cyl., lb	.14½ –	......
tanks, ton	59.00 –	69.00
Ammonium, carbonate, powd., casks, lb	.09½ –	.10
Sulphate, wks., ton	28.20 –	......
Amylacetate, tech. from pentane, tanks, lb	.45 –	......
Aqua ammonia, 26°, drums, lb	.02½ –	.03
tanks, ton	65.00 –	......
Arsenic, white, powd., bbl., lb	.04 –	.04½
Barium carbonate, bbl., ton	65.00 –	75.00
Chloride, bbl., ton	75.00 –	78.00
Nitrate, casks, lb	.09½ –	.11
Blanc fix, dry, bags, ton	60.00 –	70.00
Bleaching powder, f.o.b., wks., drums, 100 lb	2.50 –	3.00
Borax, gran., bags, 100 lb	45.00 –	......
Calcium acetate, bags, 100 lb	3.00 –	......
Arsenate, dr., lb	.07½ –	.08
Carbide, drums, ton	50.00 –	......
Chloride, flake, bags, del., ton	18.50 –	25.00
Carbon bisulphide, drums, lb	.05 –	.05½
Tetrachloride, drums, gal	.73 –	.80
Chlorine, liquid, tanks, wks., 100 lb	1.75 –	2.00
Copperas, bgs., f.o.b., wks., ton	17.00 –	18.00
Copper carbonate, bbl., lb	.19½ –	.20
Sulphate, bbl., 100 lb	5.00 –	5.50
Cream of tartar, bbl., lb	.50 –	.57
Diethylene glycol, dr., lb	.14½ –	.15½
Epsom salt, dom., tech., bbl., 100 lb	1.80 –	2.00
Ethyl acetate, tanks, lb	.107 –	......
Formaldehyde, 40%, tanks, lb	.032 –	......
Furfural, tanks, lb	.09½ –	......
Glaubers salt, bags, 100 lb	1.05 –	1.108
Glycerine, c.p., drums, extra, lb	.18½ –	.18½
Lead:		
White, basic carbonate, dry, casks, lb	.08½ –	......
Red, dry, sck., lb	.09½ –	......
Lead acetate, white crys., bbl., lb	.12½ –	.13
Lead arsenate, powd., bag, lb	.11½ –	.12
Lithopone, bags, lb	.04½ –	.04½
Magnesium carb., tech., bags, lb	.07½ –	.08
Methanol, 95%, tanks, gal	.60 –	......
Synthetic, tanks, gal	.24 –	......
Phosphorus, yellow, cases, lb	.23 –	.25
Potassium bichromate, casks, lb	.10½ –	.10½
Chlorate, pwd., lb	.09½ –	.12
Hydroxide (c'stic potash) dr., lb	.07 –	.07½
Muriate, 60%, bags, unit	.53½ –	......
Nitrate, ref., bbl., lb	.08 –	.09½
Permanganate, drums, lb	.19½ –	.20
Prussiate, yellow, casks, lb	.16 –	.17
Sal ammoniac, white, casks, lb	.0515 –	.06
Salsoda, bb., 100 lb	1.00 –	1.05
Salt cake, bulk, ton	15.00 –	......
Soda ash, light, 58%, bags, contract, 100 lb	1.05 –	......
Dense, bags, 100 lb	1.15 –	......
Soda, caustic, 76% solid, drums, 100 lb	2.30 –	3.00
Acetate, del., bbl., lb	.05½ –	.06
Bicarbonate, bbl., 100 lb	1.70 –	2.00
Bichromate, bags, lb	.07½ –	.08
Bisulphate, bulk, ton	16.00 –	17.00
Bisulphite, bbl., lb	.03 –	.04



Fairbanks-Morse Scales have earned their world-wide reputation for enduring accuracy through constant research to improve even the most minute parts—through research in the selection of the most enduring materials—through research in design to perfect each part. This has been the Fairbanks-Morse policy for over a hundred years, and it continues to be the Fairbanks-Morse policy today.

Skilled craftsmen produce these parts with the aid of modern machines. Trained assemblers put them together. A weighing machine so constructed performs accurately day after day, year after year.

Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

Fairbanks-Morse

A name worth remembering

FAIRBANKS MORSE

Diesel Locomotives · Diesel Engines
Scales · Motors · Pumps · Generators
Magnetos · Stokers · Railroad Motor
Cars and Standpipes · Farm Equipment

CHEM. & MET. Weighted Index of Prices for OILS & FATS

Base = 100 for 1937

This month	145.63
Last month	145.63
December, 1944	145.56
December, 1943	145.24

Chlorate, kegs, lb	$0.06½ –	$0.06¾
Cyanide, cases, dom., lb	.14½ –	.15
Fluoride, bbl., lb	.07 –	.08
Hyposulphite, bags, 100 lb	2.25 –	2.50
Metasilicate, bbl., 100 lb	2.50 –	2.65
Nitrate, bulk, ton	27.00 –	......
Nitrite, casks, lb	.06½ –	.07
Phosphate, tribasic, bags, 100 lb	2.70 –	......
Prussiate, yel., bags, lb	.10½ –	.11
Silicate, 40°, dr., wks., 100 lb	.80 –	.85
Sulphite, crys., bbl., lb	.02½ –	.02¾
Sulphur, crude at mine, long ton	16.00 –	......
Dioxide, cyl., lb	.07 –	.08
Dioxide, tanks, lb	.04 –	......
Tin crystals, bbl., lb	.39¼ –	......
Zinc chloride, grain, bbl., lb	.05½ –	.06
Oxide, lead free, bags, lb	.07¼ –	......
Oxide, 5% leaded, bags, lb	.07¼ –	......
Sulphate, bbl., cwt	3.85 –	4.00

OILS AND FATS

Castor oil, No. 3 bbl., lb	$0.13½ –	$0.14¼
Chinawood oil, tanks, lb	.38½ –	......
Coconut oil, ceylon, N. Y., lb	.0885 –	......
Corn oil crude, tanks (f.o.b. mill), lb	.12¾ –	......
Cottonseed oil crude (f.o.b. mill), tanks, lb	.12¾ –	......
Linseed oil, raw, car lots, bbl., lb	.155 –	......
Palm, casks, lb	.0865 –	......
Peanut oil, crude, tanks (mill), lb	.12¾ –	......
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	.11¾ –	......
Menhaden, light, pressed, dr. lb	.13 –	......
Crude, tanks (f.o.b. factory) lb	.089 –	......
Grease, yellow, loose, lb	.08½ –	......
Oleo stearine, lb	.09¼ –	......
Oleo oil, No. 1, lb	.11¼ –	......
Red oil, distilled, bbl., lb	.13 –	......
Tallow extra, loose, lb	.08½ –	......

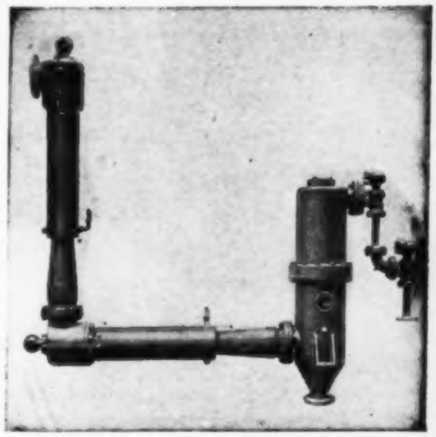
COAL-TAR PRODUCTS

Alpha-naphthol, crude, bbl., lb	$0.52 –	$0.55
Alpha-naphthylamine, bbl., lb	.32 –	.34
Aniline oil, drums, extra, lb	.11½ –	.12¼
Aniline salts, bbl., lb	.22 –	.24
Benzaldehyde, tech., dr., lb	.45 –	.50
Benzidine base, bbl., lb	.70 –	.75
Benzoic acid, USP, kegs, lb	.54 –	.56
Benzol, 90%, tanks, works, gal	.15 –	......
Benzyl chloride, tech., dr., lb	.22 –	.24
Beta-naphthol, tech., drums, lb	.23 –	.24
Cresol, USP, dr., lb	.10½ –	......
Cresylic acid, dr., wks., gal	.81 –	.83
Diphenyl, bbl., lb	.15 –	......
Diethylaniline, dr., lb	.40 –	.45
Dinitrotoluol, bbl., lb	.18 –	.19
Dinitrophenyl, bbl., lb	.22 –	.23
Dip oil, 15%, dr., gal	.23 –	.25
Diphenylamine, dr., f.o.b. wks., lb	.25 –	......
H acid, bbl., lb	.45 –	.50
Hydroquinone, bbl., lb	.90 –	......
Naphthalene, flake, bbl., lb	.07 –	.07½
Nitrobenzene, dr., lb	.08 –	.09
Para-cresol, bbl., lb	.41 –	......
Para-nitraniline, bbl., lb	.47 –	.49
Phenol, USP, drums, lb	.10 –	.11
Picric acid, bbl., lb	.35 –	.40
Pyridine, dr., gal	1.55 –	1.60
Resorcinol, tech., kegs, lb	.65 –	.70
Salicylic acid, tech., bbl., lb	.26 –	.33
Solvent naphtha, w.w., tanks, gal.	.26 –	......
Toludin, bbl., lb	.96 –	......
Toluol, drums, works, gal	.32 –	......
Xylol, com., tanks, gal	.25 –	......

MISCELLANEOUS

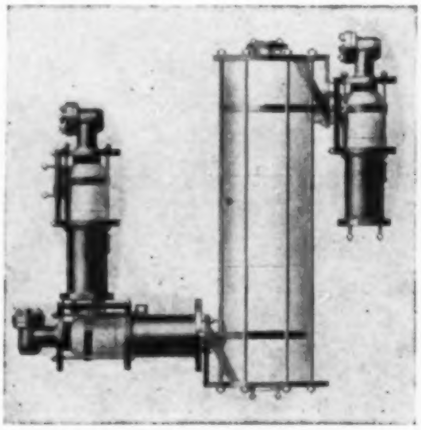
Casein, tech., bbl., lb	$0.21 –	$0.24
Dry colors		
Carbon gas, black (wks.), lb	.0365 –	.097
Prussian blue, bbl., lb	.36 –	.37
Ultramarine blue, bbl., lb	.11 –	.26
Chrome green, bbl., lb	.23 –	.33
Carmine, red, tins, lb	4.60 –	4.75
Para toner, lb	.75 –	.80
Vermilion, English, bbl., lb	2.50 –	2.60
Chrome, yellow, C.P., bbl., lb	.16 –	.17
Gum copal, Congo, bags, lb	.09 –	.55
Manila, bags, lb	.09 –	.15
Damar, Batavia, cases, lb	.10 –	.22
Kauri, cases, lb	.18 –	.60
Magnesite, calc., ton	64.00 –	......
Pumice stone, lump, bbl., lb	.05 –	.07
Rosin, H., 100 lb	7.43 –	......
Shellac, orange, fine, bags, lb	.46 –	......
Bleached, bonedry, bags, lb	.42½ –	......
T. N. bags, lb	.35½ –	......
Turpentine, gal	.92½ –	......

How the Process Industries can profit from war uses of WORTHINGTON STEAM-JET EJECTORS

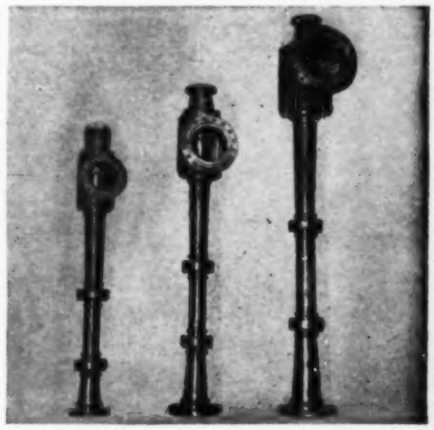


Four-stage condensing ejector, typical of four- and five-stage units used for blood plasma, penicillin, and numerous other high vacuum drying and distillation processes at pressures below 1 mm. Hg abs.

Three-stage condensing unit for intermediate vacuum applications, in the range from 10 mm. to 1 mm. Hg abs.



Three-stage condensing unit constructed of acid-resisting materials for handling highly corrosive vapors. Available in porcelain and/or Karbate in single and multi-stage units.



10", 12", 16" single-stage ejectors for handling 850°F. vapors in Houdry 100-octane aviation gasoline cracking plants.

A glance through the following representative list of war products, processes and services which utilize Worthington Steam-Jet Ejectors to full advantage for their vacuum requirements will suggest that Worthington can also meet your demands:

U.S. Navy and Maritime Commission. Atomic bombs. Explosives including toluol for TNT. Chemical warfare products. 100-octane aviation gasoline, styrene, butadiene, and synthetic rubber. Plexiglas and other plastics. Rayon and nylon. Synthetic resins and dyes. Pharmaceutical products including vitamins, DDT insecticide, blood plasma, penicillin and streptomycin.

WORTHINGTON HAS THE LINE AND THE EXPERIENCE YOU NEED

No two of the above war production jobs were alike . . . yet Worthington, through engineering ability and breadth of line, was able to meet all requirements. Application to your peace-time needs will likewise be facilitated by Worthington's experience and wide range of Steam-Jet Ejectors in single and multiple stages, condensing or non-condensing, of standard or special corrosion-resistant materials.

Whatever your vacuum requirements, from atmospheric down to 150 microns absolute pressure, Worthington can give you the benefit of its war-proved line and experience.

For further proof that in the Steam-Jet Ejector field, *there's more worth in Worthington*, write for literature, stating your vacuum requirements. *Worthington Pump and Machinery Corporation, Harrison, N. J.*

WORTHINGTON

J5-8

NEW CONSTRUCTION

	Current Projects		Cumulative 1945	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	....	$200,000	$3,325,000	$17,259,000
Middle Atlantic	$150,000	2,390,000	9,252,000	37,506,000
South	1,740,000	2,325,000	52,078,000	38,167,000
Middle West	260,000	635,000	12,299,000	67,102,000
West of Mississippi	13,250,000	1,705,000	99,062,000	95,804,000
Far West	850,000	2,990,000	20,995,000	22,816,000
Canada	....	....	9,219,000	3,331,000
Total	$16,250,000	$10,245,000	$206,230,000	$281,985,000

PROPOSED WORK

Ala., Tuscaloosa—Hunt Oil Co., Cotton Exchange Bldg., Dallas, Tex., plans to construct a refinery here. Estimated cost $500,000.

Calif., Hayward—Swift & Co., Union Stockyards, Chicago, Ill., plans to construct a fertilizer plant and office building. Estimated cost $200,000.

Calif., Lynwood—India Paint & Lacquer Co., 5894 South Central Ave., Los Angeles, Calif., plans to construct a factory building at Imperial Blvd. and Alameda St. Donald R. Warren Co., 500 South Figueroa St., Los Angeles, Engr. Estimated cost $50,000.

Fla., Jacksonville—Naco Fertilizer Co., Commodores Point, plans to construct a plant. Estimated cost $40,000.

Ga., Brunswick—Brunswick Pulp & Paper Co., Brunswick, plans to construct a paper mill. Estimated cost $1,000,000.

Ill., Peoria—Hiram Walker & Sons, Peoria, plans to construct a warehouse addition to its distillery. Smith, Hinchman & Grylls, 800 Marquette Bldg., Detroit, Mich., Archts. Estimated cost $200,000.

Md., Cumberland—Air Reduction Co., Inc., 60 East 42nd St., New York, N. Y., plans to construct a chemical plant here. Estimated cost $150,000.

Minn., Monticello—Lehigh Portland Cement Co., Allentown, Pa., plans to construct a cement plant here. Estimated cost $3,000,000.

Mo., St. Louis—Duro Chrome Corp., 1814 McNulty St., St. Louis, plans to construct a 2 story addition to its factory. Estimated cost $250,000.

Mo., Wellston (St. Louis P. O.)—Lever Bros. Co., Boston, Mass., contemplates the construction of a plant for the manufacture of soap and soap products. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., and 90 Broad St., New York, N. Y., Engr. Estimated cost of first unit $10,000,000; complete estimated cost including equipment $40,000,000.

N. C., Wilmington—Smith-Douglass Co., Inc., Board of Trade Bldg., Norfolk, Va., plans to construct a fertilizer plant here. Estimated cost will exceed $200,000.

O., Cleveland—Ferro Enamel Co., 4150 East 56th St., plans alterations to its factory. Estimated cost $60,000.

Ore., Portland—Mt. Hood Soap Co., 328 N. W. Glisan St., plans to construct a 4 story soap plant and two warehouses. Estimated cost $200,000.

Ore., Willbridge—California Asphalt Corp., 225 Bush St., San Francisco, Calif., plans to construct an asphalt refinery. Estimated cost $400,000.

CONTRACTS AWARDED

Calif., Berkeley—Colgate-Palm Olive-Peet Co., 810 Carleton St., has awarded the contract for the construction of a factory to Austin Co., 618 Grand Ave., Oakland. Estimated cost $400,000.

Calif., Glendale—Southern California Plastic Co., 2773 N. Broadway, Eagle Rock, has awarded the contract for a 1 story factory and office building to Ted R. Cooper Co., 1121 South Hill St., Los Angeles. Estimated cost $50,000.

Calif., Pittsburg—Dow Chemical Co., (Western Div.) Industrial Rd., has awarded the contract for an addition to its chemical plant to Austin Co., 618 Grand Ave., Oakland.

Calif., San Jose—International Minerals & Chemical Corp., 20 N. Wacker Dr., Chicago, Ill., has awarded the contract for an amino food flavoring products plant, including pilot plant and development buildings, and 2 story engineering office building, to Stone & Webster Engineering Corp., 49 Federal St., Boston 7, Mass. Estimated cost $2,500,000.

Mich., Detroit—Cook Paint & Varnish Co., 3301 Bourke St., has awarded the contract for a 1 story addition to its factory to Barton-Malow Construction Co., 2631 Woodward Ave. Estimated cost $50,000.

Mich., Trenton—Monsanto Chemical Co., Trenton, has awarded the contract for an addition to its plant to Esslinger-Misch Co., 159 East Columbia St., Detroit. Estimated cost $200,000.

Mo., St. Louis—Lambert Pharmacal Co., 2117 Franklin Ave., has awarded the contract for an addition to its plant to Gamble Construction Co., 620 Chestnut St. Estimated cost will exceed $75,000.

N. H., Keene—Pittsburgh Plate Glass Co., 310 Marlboro St., has awarded the contract for a 2 story factory to Glenroy Scott, 28 Washington St. Estimated cost $200,000.

N. Y., Greece—Distillation Products, Inc., subsidiary of Eastman Kodak Co. and General Mills, Inc., has awarded the contract for the construction of a factory here to A. W. Hopeman & Sons Co., 569 Lyell Ave., Rochester. Estimated cost $750,000. 755 Ridge Rd., W., Rochester.

N. Y., Rochester—Eastman Kodak Co. has awarded a contract for the construction of a 3 story factory for increasing the flood of color films, to Ridge Construction Co., a subsidiary company. Estimated cost $1,000,000.

O., Akron—Goodyear Tire & Rubber Co., Akron, has awarded the contract for the construction of a pilot plant and plastics laboratory to Hunkin-Conkey Construction Co., Chester-12th Bldg., Cleveland. Estimated cost $250,000.

Pa., Erie—Hammermill Paper Co., East Lake Rd., has awarded the contract for the construction of a 1 story, 240x600 ft. warehouse to Morton C. Tuttle Co., 862 Park Sq. Bldg., Boston, Mass. Estimated cost $600,000.

Pa., Oakmont—Thompson & Co., paint manufacturers, 1085 Allegheny Ave., has awarded the contract for altering and constructing 1 story addition to factory to The Trimble Co., 1719 Pennsylvania Ave., N. S., Pittsburgh. Estimated cost $40,000.

Tenn., Johnson City—Burlington Mills, Greensboro, N. C., have awarded the contract for a rayon mill to Barger Bros., Mooresville, N. C. Estimated cost $100,000.

Tex., Dallas—Procter & Gamble, Dallas, has awarded the contract for additional soap manufacturing facilities to H. K. Ferguson Co., 3600 S. Lamar St. Estimated cost $105,000.

Tex., Houston—McKesson & Robbins, Inc., 1511 Preston Ave., has awarded the contract for a commercial office and warehouse to Linbeck & Dederick Construction Co., P. O. Box 2541, Houston. Estimated cost $400,000.

Tex., Houston—Shell Oil Co., Shell Bldg., has awarded the contract for an oil exploration and production research laboratory, to Austin Co., Second National Bank Bldg. Estimated cost $1,000,000.

Tex., Quitman—Saska Corp., Esperson Bldg., Houston, will construct a natural gasoline plant. Work will be done by owners. Estimated cost $125,000.

Va., Jarratt—Johns-Manville Corp., 22 East 40th St., New York, N. Y., has awarded the contract for an addition to its factory to Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass.; substructure work to Consolidated Engineering Co., 20 East Franklin St., Baltimore, Md. Estimated cost $1,000,000.

W. Va., Nitro—American Viscose Corp., 9th and Market Sts., Wilmington, Del., has awarded the contract for an addition to its plant to J. P. Pettyjohn Co., 212 8th St., Lynchburg, Va. Estimated cost $1,225,000.

Wis., Appleton—Universal Paper Co., Appleton, has awarded the contract for a 1 story, 90x145 ft. warehouse to Hoffman Construction Co., 1519 North Oneida St.

Wis., Milwaukee—Medusa Portland Cement Co., Cleveland, O., has awarded the contract for 6 cement silos to Jas. Stewart Corp., 231 South La Salle St., Chicago, Ill. Estimated cost $95,000.